NOTICE

All drawings located at the end of the document.

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FINAL
OU-2 IM/IRA IMPLEMENTATION AND OPERATION PLAN
SOIL VAPOR EXTRACTION PILOT TEST

Rocky Flats Plant

(Operable Unit No. 2)

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant
Golden, Colorado

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APPROVED BY:

Project Manager
Environmental Restoration

02-11-94
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF DRAWINGS

LIST OF APPENDIXES

1.0 BACKGROUND

A Phase I Remedial Investigation (RFI/RI) was conducted at Operable Unit No. 2 (OU-2) in 1987. It consisted of preparing detailed topographic maps, radiometric and organic vapor screening surveys, surface geophysical surveys, a soil gas survey, a boring and well completion program, soil sampling, and surface and groundwater sampling. Phase I data did not completely define the nature and extent of contamination for the purpose of conducting a baseline risk assessment or identifying feasibility study (FS) remedial alternatives.

Therefore, a Phase II RFI/RI was started in October 1991 to further characterize OU-2. The Phase II RFI/RI includes the advancement of soil borings into waste sources to characterize waste materials remaining in place, installation of groundwater monitoring wells adjacent to some of the boreholes to characterize groundwater quality directly beneath the suspected waste source sites, and installation of additional alluvial monitoring wells to further characterize and monitor groundwater flow and quality at OU-2.

In recent years, the Department of Energy (DOE) has prepared several Interim Measure/Interim Remedial Action Plans (IM/IRAPs) to address groundwater, surface water, and soil contamination at OU-2. A draft of the first plan was prepared by DOE in 1989 and addressed the contaminated OU-2 groundwater. The plan was prepared based on limited knowledge of the nature and extent of groundwater contamination at OU-2. Regulatory agency review of the document determined that, although an Interim Measure/Interim Remedial Action (IM/IRA) for groundwater is required by the Interagency Agreement (IAG), insufficient information existed on the nature and extent of groundwater contamination to pursue effective groundwater remediation at that time. Therefore, pursuit of an IM/IRA for remediation of OU-2 groundwater was deferred until Phase II RFI/RI data were collected.

In March 1991, DOE submitted an IM/IRA addressing contaminated surface water within the South Walnut Creek Drainage Basin. The plan proposed that contaminated surface water be

collected and treated by chemical precipitation and microfiltration for removal of radionuclides and metals, followed by granular activated carbon (GAC) adsorption for removal of volatile organic compounds (VOCs). Installation of the surface water IM/IRA was completed on April 24, 1992, and the system was started on April 27, 1992. Pilot testing of the South Walnut Creek IM/IRA treatment system is scheduled to continue through the summer of 1993.

DOE submitted a second surface water IM/IRA for OU-2 in October, 1991. This plan considered several alternatives for the collection and treatment of contaminated surface seepage within the Woman Creek Basin. The plan also presented a detailed evaluation of the impacts to human health and the environment associated with the contaminated seepage. The results indicated that no immediate threat to public health or the environment existed. The IM/IRAP presented the No Action Alternative as the preferred alternative. Meetings between DOE, the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Health (CDH) were held subsequent to submission of the IM/IRAP to discuss alternative IM/IRAs that could be conducted at OU-2 in lieu of the originally conceived Woman Creek Basin surface water action. At the conclusion of these discussions, a decision was made to pursue an IM/IRA that addressed suspected residual and free-phase VOC contamination in the subsurface at one or more OU-2 areas. It was also decided that because subsurface VOC contamination at OU-2 does not pose an immediate threat to public health and the environment, IM/IRA should primarily be used to gain information that will aid in selection and design of final remedial actions at OU-2.

In September 1992, DOE released a final Subsurface IM/IRAP to investigate the removal of VOC contamination from three areas within OU-2. Specifically, the Soil Vapor Extraction (SVE) technology would be pilot tested within, or adjacent to, suspected VOC source areas in the 903 Pad, Mound and East Trenches.

The purpose of this Implementation and Operation Plan (IOP) is to provide specific guidance for the installation and operation for this pilot test. In addition, specifications are provided for reference (Appendix A).

This IOP will reference the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993), EG&G Standard Operating Procedures (SOPs), and the OU-2 Health and Safety Plan.

2.0 PILOT TEST DESIGN AND INSTALLATION

2.1 MOBILIZATION

To meet the pilot test schedule, procurement will begin for the materials identified in Subsections 2.4 to 2.6 as soon as this IOP has been approved by EG&G and EG&G has given Woodward-Clyde Federal Service (WCFS) notice to proceed with Task 3, Install Wells and Ancillary Equipment.

The following training is required as part of the mobilization for this pilot test:

- Rocky Flats Plant (RFP) SOP training for drilling (supplied by WCFS)
- RFP SOP and equipment training for GC operators (supplied by WCFS)
- SVE unit training (supplied by EG&G)
- RFP specific training (e.g., RAD training, GET training)

2.2 INSTALLATION EXTRACTION VENTS AND WELLS

The installation and assembly of the OU-2 SVE system is contingent upon the drilling and construction of nine wells within the Rocky Flats Alluvium and the No. 1 sandstone. The well configuration and design was prepared in the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993). The construction specifications and site layout schematics are shown in Drawings 1 through 8 of the OU-2 Subsurface IM/IRA Pilot Test Plan. The site plan is shown in Drawing 50715-101 of this IOP. Work associated with the drilling and installation of these wells will be performed in accordance with the applicable RFP SOPs. All work will be performed in accordance with the project Health and Safety Plan found in Appendix B of this IOP.

2.2.1 Site Layout and Clearing

The specific field locations of the wells will be identified and cleared by RFP safety personnel prior to field mobilization of the drill crew. Each site will be designated by a stake driven into the ground and labeled with the appropriate boring or vent designation. These sites will be located in the field by using the specifications provided in Drawings 1 and 2 of the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993) for the spatial distribution of the respective vent wells. All vent injection and monitoring wells are located with respect to the site baseline. The site baseline for northeast trench T-3 IHSS 110 is defined as pin flag 110-7 of the Applied Science Inc (ASI) soil gas survey. This baseline is the center line of Wells SV1 and SI1. All other wells and probes are located from this centerline.

2.2.2 Mobilization

All drilling and well construction supplies and equipment necessary for the completion of this program will be staged at RFP in the EG&G supplied storage areas prior to start-up of field operations. Sufficient quantities of grout, polyvinyl chloride (PVC)/carbon steel casing and screen, steel isolation casing, augers and other ancillary equipment will be available to facilitate the timely completion of well construction.

RFP SOP training will be completed by all field personnel prior to start of any field activities. This training will be provided by WCFS and RFP personnel at RFP. Complete familiarization with SOP requirements concerning work practices is required by appropriate field personnel prior to start up of the field program.

The drill rig and down hole drilling equipment (augers, bits, hex rods, etc) will be decontaminated at the main decontamination facility before mobilizing to the SVE field site, per SOP FO. 03, General Equipment Decontamination, and SOP FO.04, Heavy Equipment

Decontamination. The drill rig will also be inspected and approved by both WCFS and RFP safety personnel before it will be allowed to proceed to the SVE Pilot Study area.

2.2.3 Drilling and Installing Wells

Table 2-1 summarizes the drilling program and includes the well specifications, projected total depths and sampling schedule for the OU-2 SVE Pilot Study. The actual drilling and sampling of each well will be in conformance with SOP GT.02, Drilling and Sampling Using Hollow-stem Auger Techniques, and is presented in Section 3.5. Alluvial wells will be drilled and sampled to depth using 3.5-inch ID hollow-stem augers. Samples will be collected in stainless-steel VOC liner within a 2-foot split spoon over the entire well depth. VOC samples exhibiting the highest PID readings will be selected for analysis as shown on Table 2-1. Composite samples will be collected from the 5-, 10-, and 15-foot levels from extraction well AV1 for radionuclide analysis. The prescribed compositing technique is described in the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993). Section 3-5 and Table 2-1 identify the samples to be collected and the analytical requirements required. Sample numbers will be established by RFEDS for transfer of sampling data to EG&G. After sampling, the alluvial wells will be reamed using larger augers, and the well installed.

The bedrock wells will be drilled to a maximum of 90 feet or upon encountering 5 consecutive feet of claystone. The alluvial section of these wells will be drilled and sampled as described above. Only one VOA sample will be taken from this interval but all three radionuclide samples will be taken from SV1. Refer to Section 3.5 for sampling intervals and analytical procedures. After the alluvial sampling, larger diameter augers will be used as required to ream the boring to the specified well diameter for the isolation casing. This casing will be installed per SOP GT.03, Isolating Bedrock from Alluvium with Grouted Surface Casing. Once the isolation casing is set, the well will be drilled to depth and

TABLE 2-1
ROCKY FLATS PLANT
OU-2 SVE PILOT STUDY
DRILLING SUMMARY TABLE

	# Wells	Projected Depth (ft)	Boring Diameter	Surface Casing	Riser Length	Screen Length* 0.01" Sch 40 PVC	Samples #	Samples Type	Samples Depth
Alluvial Wells									
Extraction	1	20	8"	NA	1 - 4"x 12' Sch40 PVC	1 - 4"x 10'	3	VOC	Highest PID or at 6' bgs, mid and bottom of boring
							3	Rad Screen	Collected with the VOCs
							3	Composites	5, 10, and 15' bgs
							3	Rad Screens	Collected with composites
Injection	1	18	8"	NA	1 - 4" x 10' Sch40 CS	1 - 4" x 10' 0.01 Sch 40 CS	0	NA	NA
Pressure Monitors	3	16	4"	NA	3 - 2" x 15' Sch40 PVC	3 - 2" x 3'	3	VOC	Highest PID or at midpoint of boring
							3	Rad Screens	Twin VOCs

	# Wells	Projected Depth (ft)	Boring Diameter	Surface Casing	Riser Length	Screen Length* 0.01" Sch 40 PVC	Samples #	Samples Type	Samples Depth
Bedrock Wells									
Extraction	1	50 - 72	12" x 22' 8" x 22 - 72'	1 - 8" x 20 - 22' carbon steel	4" x 20 - 24' Sch40 PVC	4" x 26 - 68'	3 3 3 3	VOC Rad Screen Composites Rad Screens	Highest PID or at 6' bgs, mid and bottom of boring Twin VOCs 5, 10, and 15' bgs Twin Composites
Injection	1	50 - 72	12" x 22' 8" x 22 - 72'	1 - 8" x 20 - 22' carbon steel	4" x 20 - 24' Sch40 CS	4" x 26 - 68' 0.01 Sch40 CS	0	NA	NA
Pressure Monitors	2	50 - 72	2 - 8" x 22' 2 - 4" x 22 - 72'	2- 4" x 22' carbon steel	2 - 2" x 20 - 24' Sch40 PVC	2 - 2" x 26 -68'	2 2	VOC Rad Screens	Highest PID or at midpoint of boring Twin VOCs

* All sand used in filter pack around screened interval will be size 16 - 40 silica

PVC - Polyvinyl chloride
CS - Carbon steel
bgs - below ground surface

sampled according to Table 2-1. Down hole drilling and sampling equipment will be decontaminated between drill sites as required by SOP FO.03, General Equipment Decontamination.

Well construction will be performed in accordance with SOP GT.06, Monitoring Well and Piezometer Installation. As per the SOP, RFP potable water will be used as necessary to create a hydraulic head to prevent the blowback of flowing sands into the hollow-stem augers as drilling and/or well construction proceeds. Potable water will be obtained from designated fire hydrants and will be coordinated with the RFP fire department prior to obtaining water.

All soil and liquid waste generated by drilling and well installation activities will be containerized per SOP FO.08, Handling of Drill Cuttings and Fluids and FO.10, Receiving, Labeling and Handling Environmental Materials Containers. Assuming 44 feet of 12-inch boring, 226 feet of 8-inch boring, and 192 feet of 4-inch boring with a 20 percent volume increase factor yields a minimum of 156 cubic feet of dry soil waste. Personal protective equipment will be disposed of as directed by FO.06, Handling of Personal Protective Equipment. Core recovered in drilling operations will be boxed and stored in the EG&G storage facility.

Document Change Notifications (DCN) for the SOPs have been approved and are found in Appendix B:

2.2.4 Sequencing of Events

The following tentative work schedule is designed to maximize productivity by minimizing the amount of non-drilling time caused by standby while allowing grouted surface casings to cure. The deepest wells will be completed first to gain valuable subsurface data indicating specific conditions to be encountered during drilling. As surface isolation casing is set and curing, an alluvial well will be drilled and installed before returning to drill and install the

bedrock well. The following schedule is aggressive and may lapse slightly during the bedrock well installation phase due to difficulties in setting the alluvial isolation casings:

1. Drill sample bedrock extraction well (SV1) to alluvium/sandstone contact.
   Ream and set surface casing.
   Move to alluvial extraction well (AV1).
   Drill and sample alluvial extraction well (AV1).

2. Ream alluvial extraction well and build well (AV1).
   Move back to bedrock extraction well (SV1).
   Drill and sample to total depth (TD), ream bedrock extraction well to proper diameter.

3. Build bedrock extraction well (SV1).
   Move to bedrock injection well (SV1).
   Drill and sample (SI1) to alluvial/bedrock contact.
   Ream bedrock injection well (SI1) to proper diameter.
   Set surface casing.

4. Move rig to alluvial injection well (AI1).
   Drill to TD.
   Ream alluvial injection well (AI1) to proper diameter.
   Build well.
   Move rig to bedrock injection well (SI1).

5. Drill sample bedrock injection well (SI1) to TD.
   Ream injection well boring (SI1).
   Build bedrock injection well (SI1).

6. Move rig to bedrock PM well (SPM2).
   Drill to bedrock.
   Ream well and set surface casing.

7. Move rig to bedrock PM well (SPM1).
   Drill to bedrock.
   Ream and set surface casing.
   Move rig back to first bedrock PM well (SPM2).

8. Drill SPM2 to TD.
   Ream and build well.
   Move to second bedrock PM well (SPM1).

9. Drill SPM1 to TD.
   Ream and build well.
   Move rig to alluvial PM well (APM1).

10. Drill and sample alluvial PM well to TD (APM1).
    Ream boring.
    Build well.
    Move rig to second alluvial PM well (APM2).

11. Drill and sample APM2 well to TD.
    Ream boring.
    Build well.

12. Move rig to third alluvial PM well (APM3).
    Drill and sample APM3 well to TD.
    Ream boring.
    Build well.

2.3 SITE PAD

Site preparation will be the initial on-site field effort. The primary task for this phase is the construction of an approximately 6,000-square-foot work area, approximately 6 inches thick, to provide a working area for the SVE trailer, groundwater storage tanks, and electric generator. An access road approximately 6 feet wide and 200 feet long will also be constructed. This work will require the placement and leveling of approximately 200 tons of 3/4-inch diameter washed crushed rock to the depth of approximately 6 inches. This quantity is based on best engineering estimates and can be expected to increase if it is necessary to use additional material to fill localized low spots in the work area. The site pad is shown in Drawing 50715-101.

2.4 PROCESS EQUIPMENT

The following process equipment (Figure 2-1) will be installed:

- Two 5-gpm Grundfos submersible pumps and instrumentation as described in Subsection 2.5.

- Two 10,000-gallon double-walled, horizontal, skid mounted storage tanks, environmental liquid tank piping and instrumentation (as described in Subsections 2.5 and 2.6, respectively).

- Mobile SVE Pilot Unit (a description of the unit is found in the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993)).

The 5-gpm pumps specified in the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993) may be oversized for field conditions. If operating conditions dictate, smaller capacity pumps may be needed. Specifications, materials of construction, and testing procedures for the pumps and tanks are in Appendix A. Specifications and operating procedures for the mobile pilot unit are found in the RTG Operations and Maintenance Manual.

2.5 PIPING

Specifications, materials of construction, testing procedures and quality assurance/quality control (QA/QC) requirements for the mechanical piping are in Appendix A.

Due to elevated operating temperatures, air injection riser pipe will be Schedule 40 (SCH 40) carbon steel (CS) pipe. Fittings will have threaded connections for ease of installation and removal in the field. Spools requiring welding (i.e., sample port thred-o-lets) will be shop-fabricated. Air injection screens will be stainless steel with .01-inch slots.

Vapor extraction risers and screens will be SCH 80 PVC with socket-end fittings. Vent piping from the groundwater storage tanks will be SCH 80 PVC with socket-end fittings.

Groundwater extraction piping above ground will be double contained with 3/4-inch polyethylene (PE) internal pipe and 3-inch SCH 80 PVC external pipe. All vapor injection well and wellhead carrier piping will be SCH 80 CS with threaded connections and containment piping SCH 40 PVC with flanged connections. The annular space of the double contained pipe will be provided with leak detection. All double-contained piping will be covered with 1-inch preformed fiberglass insulation with snap-on all weather jackets.

External PVC piping will be painted with a white, water-based latex primer and a white, water-based latex paint to protect the piping from ultraviolet light. All piping will be supported on pipe stanchions embedded in the ground without concrete bases using standard pipe saddles, insulation shields, and u-bolts.

The groundwater extraction pumps will be controlled at the well head with a throttling-type globe valve with a pressure gauge on its upstream side and a low level shut-off in the well.

Air injection well block valves will be 4-inch butterfly valves with ductile iron body and disc and EPDM seats. EPDM seats are a rubber material capable of a temperature range of -40°F to 250°F. Sample port valves will be 1/2-inch true union ball valves with brass body and ball, teflon seat, and female pipe thread (FPT) end connections.

Extraction well block valves will be 6-inch butterfly valves with PVC body and disc and EPDM seats. Sample port valves will be 1/2-inch true union ball valves with PVC body and disc and teflon seats.

Groundwater extraction treatment pump throttling valves will be 1-inch angle globe valves with bronze body and teflon disc with FPT end connections.

Check valves for groundwater extraction piping will be 3/4-inch swing check with iron body BUNA-N disc with FPT end connections. Sample port and gauge valves will be 1/2-inch true union ball valves with brass body and ball, teflon seat, and FPT end connections. Both teflon and BUNA-N are materials capable of withstanding a wide temperature range, -20°F to 300°F for teflon and 0°F to 212°F for BUNA-N.

The groundwater storage tank vent vacuum/pressure relief valve will be a 1-inch valve with PVC body and EPDM seals.

2.6 ELECTRICAL POWER, CONTROL, AND INSTRUMENTATION

Specifications, materials of construction, testing procedures, and QA/QC requirements for the electrical controls and instrumentation are in Appendix A.

2.6.1 Leak Detection

A single point type leak detection system will be provided for the groundwater storage tank and the double containment piping. Sensors will be located in the tank annulus and in low points in the piping system. The annunciator panel will be installed in a weather-protected National Electrical Manufacturer's Association (NEMA) 12 enclosure located at the tanks.

2.6.2 Electrical Work

The electrical work will consist of materials and labor necessary for exterior electrical installation to the trailer including:

- Hook up of electrical power to the SVE trailer power distribution system from the 125 kW portable generator
- Install heat trace system on the water piping
- Install leak detection system as described above

- Install electrical supply to groundwater recovery pumps
- Install electrical power supply to the groundwater storage tank immersion heaters
- Install conduit between the SVE trailer, the groundwater storage tank, groundwater extraction pumps, the leak detection systems, heat tracing, and the generator
- Install level transmitters in the groundwater storage tanks for shutdown interlock capability between groundwater storage tanks, groundwater extraction wells, and the knockout drum pump mobile SVE trailer

The well pumps will be controlled in the automatic mode by the PLC using high- and low-level sensors in the extraction well and high and high-high level transmitters in the storage tanks. Pump flow will be set manually by a throttling gate valve during start-up. Well level will be set manually by the positioning of the level switches.

The electrical work will be performed to the following standards:

- National Electrical Code
- NEMA
- Rocky Flats Plant Standards

  - SE-102, Standard for AC Motors
  - SE-103, Standard for Electrical Wiring
  - SE-112, Standard for Electrical Conduit and Fittings

An electrical layout is provided in Drawing 50715-102.

3.0 PILOT TEST PLAN

The SVE pilot test operations are divided into the following phases: system operations (SO) testing, pilot testing, and sustained operations (EG&G 1993). SO testing will ensure that the SVE system is operating as designed by others prior to conducting the pilot tests. If the system does not operate as designed, WCFS will provide the requirements for system changes to EG&G. The pilot tests will determine the range of operating conditions for various system configurations. This information will determine the optimal operating configuration yielding the maximum contaminant removal to be used during the sustained operations period. The decision to conduct sustained operations will be based on the ability of the system to successfully remove VOCs from the subsurface. The sustained operation will be conducted if the VOC removal rate of one of the pilot tests is greater than 1 pound per day. This sustained operation will be used to estimate the system's projected cumulative and individual (alluvium and sandstone) contaminant removal rates, and each individual radius of influence. This information will be plotted versus time and used to estimate projected contaminant removal rates. These data will be evaluated along with the system operating costs, to determine the benefit of returning to the East Trenches Area IHSS 110 pilot test site for IM/IRA operation (final project phase).

3.1 SYSTEM OPERATIONS TESTING

Following installation of the wells and SVE pilot equipment, SO testing procedures will be initiated to verify the proper design and operation of the system. The SO testing will be conducted in accordance with the SO testing plan (Appendix C). This will involve an inspection of the system components. This inspection will include, but not be limited to, the following equipment:

- Piping - visually examine for cracks, loose connections, and possible leaks.
- Valves - verify proper operation.

- Blowers - follow manufacturer's inspection procedures (i.e., check oil, belts, etc.).

- Knockout Drum/Demister - follow manufacturer's inspection procedures.

- GAC Units - follow manufacturer's inspection procedures.

- HEPA Filters - inspect filters for debris or blockage.

- Alarms/Automatic Shutdowns - check for proper operation at design settings, follow manufacturer's inspection procedures (O&M) manual.

- Monitoring Equipment/Instrumentation - follow manufacturer's inspection and calibration procedures (O&M manual).

Upon completion of the initial inspection, the blowers will be "bumped" to verify the proper air flow direction. Bumping a blower involves turning the blower on briefly, with only dilution air supplied (i.e., the dilution air is fully opened, while all system vents remain closed), and checking the air flow direction.

The SO testing is summarized in Appendix C in the SO checklist.

3.2 PILOT TESTING

After completion of the SO testing, the pilot tests will be initiated. These tests will be of relatively short duration and will be designed to determine the range of operating conditions that can be achieved by various system configurations, and the optimal operating conditions for sustained operations of the SVE system. In addition, the pilot tests will be used to estimate the capacity and changeout requirements for the GAC and HEPA units. Information

gathered during the pilot testing will be maintained in a scientific notebook and reported biweekly to the EG&G project manager. The time required to conduct the pilot tests is expected to be approximately 4 to 6 weeks.

The following subsections outline the pilot tests to be performed following system SO testing. There will be a total of nine pilot tests, and each test will include one to three discrete runs. The nine pilot tests are listed below:

- Pilot Test No. 1 - Initial Vapor Treatment System Performance
- Pilot Test No. 2 - Alluvium System Performance
- Pilot Test No. 3 - Sandstone System Performance
- Pilot Test No. 4 - Concurrent Groundwater Extraction and Sandstone System Performance
- Pilot Test No. 5 - Concurrent Alluvium and Sandstone System Performance
- Pilot Test No. 6 - Alluvium Passive Air Inlet Performance
- Pilot Test No. 7 - Sandstone Passive Air Inlet Performance
- Pilot Test No. 8 - Alluvium Forced Air Inlet Performance
- Pilot Test No. 9 - Sandstone Forced Air Inlet Performance

TABLE 3-1
OVERVIEW OF PILOT TESTS

Pilot Test No.	Purpose	Configuration	Minimum Operating Time	Week Number
1	Evaluate performance of vapor treatment system to ensure that no VOC breakthrough occurs; pressure check system; check instrumentation	AV1 open; SV1 vent closed; supply ambient air as necessary	4 hr.	1
2	Evaluate alluvium system performance	AV1 open; SV1 vent closed; supply ambient air as necessary	48 hr.	2
3	Evaluate sandstone system performance without groundwater extraction	AV1 closed; SV1 open; supply ambient air as necessary	48 hr.	2
4	Evaluate sandstone system performance with groundwater extraction	AV1 closed; SV1 open; supply ambient air as necessary	48 hr.	3
5	Evaluate interaction between alluvium and sandstone systems	AV1 open; SV1 open; supply ambient air as necessary; groundwater extraction based on results on Test 4	16 hr.	3
6-7*	Evaluate passive air inlet	Use configuration from Tests 2 and 3; opening the passive air inlets	16 hr. each	4
8-9*	Evaluate air injection	Use configuration from Tests 2 and 3; supply air injection	16 hr. each	4

* Configuration based upon earlier pilot test results

The various system configurations and minimum operating times to be employed for the pilot tests are summarized in Table 3-1 Actual running times will be based on the time required to achieve steady state vacuum pressure distribution in the subsurface. The pilot tests will be run until the steady state condition is achieved. If this condition is established before the minimum operating time has expired, the test will be continued for the minimum operating time.

The measurements made during these tests will be used to evaluate air permeability of individual strata and to estimate the time required to reach steady state operation in each stratum as noted in the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993). The type and frequency for measurements taken on each pilot test are presented in Appendix D.

3.2.1 Pilot Test No. 1 - Initial Vapor Treatment System Performance

Pilot Test No. 1 will evaluate the performance of the SVE treatment system following start-up to verify that contaminants are not discharged to the atmosphere, that safe operating conditions exist, and how the system performs as compared to the design basis. In addition, Pilot Test No. 1 will provide a pressure check for the system under operating conditions and will verify proper operation of the SVE unit equipment and instrumentation. Pilot Test No. 1 will evaluate the performance of the GAC units by establishing the VOC concentrations in the stack. This concentration is estimated to be at or near the detection limit of the chemical analysis method.

To prevent exhausting the carbon units and potential exothermic reactions during the pilot tests, Pilot Test No. 1 will start off with a 20 scfm flow rate from AV1. PID readings of total VOCs would be taken every fifteen minutes on the extracted soil gas. Carbon bed temperature will also be monitored. The soil gas flow rate from AV1 would be increased systematically until a safety level of total VOCs is reached.

For Pilot Test No. 1, the alluvium vapor extraction vent (AV1) will be fully opened and the sandstone extraction vent (SV1) will be closed. If possible, Pilot Test No. 1 will be performed at an operating pressure of 100 inches of water vacuum, as measured at AV1. Dilution air will be supplied to the system blowers as necessary to keep an operating pressure of 100 inches of water vacuum.

Measurements to be taken during Pilot Test No. 1 are outlined in Appendix D. Within 15 minutes of start-up, all the parameters listed in Appendix D will be collected except the hydrocarbon samples. Should the initial direct reading of the stack result in an increase of 10 response units on the HNu, or its equivalent, then a hydrocarbon sample will be taken and submitted for analysis. A Selective Alpha Air Monitor (SAAM) will continually monitor the effluent gas in the stack for alpha radiation. High alpha levels trip the alarm and the system will be automatically shutdown. Further pilot tests will be suspended pending the analysis and reevaluation

Once the initial measurements are collected, the frequency at which measurements are taken throughout the remainder of the test is outlined in Appendix D.

3.2.2 Pilot Test No. 2 - Alluvium System Performance

Pilot Test No. 2 will evaluate the performance of the alluvium vapor extraction vent (AV1) and will estimate the alluvium's air permeability. Pilot Test No 2. results will be used to evaluate the following:

- AV1 air flow rates with varying operating pressures
- Contaminant removal at AV1 with varying operating pressures
- Radius of influences of AV1 with varying operating pressures

- Maximum radius of influence of AV1

- Air permeability of the alluvium will be estimated in accordance with the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993)

- Time required to reach steady-state in the alluvium

Pilot Test No. 2 will consist of three separate runs, with each discrete run being performed at a different operating pressure. An identical series of measurements will be taken during each run of Pilot Test No. 2 as outlined in Appendix D. However, pressure measurements taken for each run will vary from the schedule proposed in Appendix D, due to the importance of early subsurface pressure data. The optimal AV1 operating configuration will be determined as the operating pressure resulting in the maximum subsurface vacuum measurements made at APM1, APM2, APM3, and AI1 while the system is operating within the allowable blower temperature differential.

For all three runs of Pilot Test No. 2, AV1 will be opened and SV1 will be closed. Dilution air will be supplied to the system blowers as necessary. Individual runs of Pilot Test No. 2 will be conducted until steady-state operation is achieved (minimum of 16 hours per run). Steady-state operation will be defined as being attained when the last three subsurface pressure measurements from PM probe APM3 (the PM probe farthest form AV1) are within 5 percent of each other. If the pilot test requires greater than 24 hours to attain less than 5 percent difference between measurements, the criteria will be increased to a 10 percent difference between measurements.

Measurements to be taken during Pilot Test No. 2 are outlined in Appendix D. Initially, within 15 minutes of start-up, all the parameters listed in Appendix D will be collected. After the initial measurements are collected, the frequency at which these measurements are collected for the Test No. 2 is outlined in Appendix D. Due to the importance of early pressure data, WCFS is proposing to collect pressure measurements every 10 minutes until

pressure readings are within 20 percent of each other. Once four consecutive pressure measurements at the monitoring probes are within 20 percent of each other, the original testing schedule will be resumed until the end of the test. Pilot Test No. 2 will be approximately 48 hours in duration.

3.2.3 Pilot Test No. 3 - Sandstone System Performance

Pilot Test No. 3 will evaluate the performance of the sandstone vapor extraction vent (SV1) without groundwater extraction, and will estimate the vadose sandstone's air permeability. However, should the groundwater table rise 30 inches or more within SV1 during system operations, groundwater extraction will be initiated and continued at a rate such that the depth to groundwater within SV1 returns to and remains at its original level. This process will consist of turning on SV1's submersible pump and reducing the water level in SV1 to its original level. SI1's submersible pump is then activated to maintain SV1's water level. A water level monitor providing actual water level measurements will be used to maintain water level in the well. Pumps will be run in the manual position and the hand valve in the groundwater piping will be used to throttle the discharge. Pilot Test No. 3 results will be used to evaluate the following:

- SV1 air flow rates with varying operating pressures
- Contaminant removal rates at SV1 with varying operating pressures
- Radius of influences of SV1 with varying operating pressures
- Maximum radius of influence of SV1

- Air permeability of the vadose sandstone will be evaluated in accordance with the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993)

- Time required to reach steady-state in the vadose sandstone

Pilot Test No. 3 will consist of three separate runs, with each individual run being performed at a different vent operating pressure. An identical series of measurements will be taken during each run of Pilot Test No. 3 as outlined in Appendix D. However, pressure measurements taken for each run will vary from the schedule proposed in Appendix D, due to the importance of early subsurface pressure data. The optimal operating configuration will be determined as the operating pressure resultinXg in the maximum subsurface pressure measure made at SPM1, SPM2, and SI1.

For all three runs of Pilot Test No. 3, SV1 will be opened and AV1 will be closed. Groundwater will not be extracted during Pilot No. 3, unless the groundwater table rises 30 inches or more within SV1 during system operations. Dilution air will be supplied to the system as required. Individual runs of Pilot Test No. 3 will be conducted until steady-state operation is achieved (minimum of 16 hours in duration for each run). Steady-state operation will be defined as being attained when the last three subsurface pressure measurements from PM probe SPM2 (the PM probe farthest from SV1) are within 5 percent of each other. If this pilot test requires more than 24 hours to establish a 5 percent difference, then the criteria will be increased to a 10 percent difference.

Measurements to be taken during Pilot Test No. 3 are outlined in Appendix D. Initially, within 15 minutes of start-up, the parameters listed in Appendix D will be collected. Once the initial measurements are collected, the frequency at which these measurements are taken throughout Test No. 3 are outlined in Appendix D. Due to the importance of early pressure data, WCFS is proposing to collect pressure data every 10 minutes until subsurface pressure measurements, at the monitoring probes, are within 20 percent of each other four consecutive times. Once four consecutive pressure measurements reach this state, the original testing

schedule will be resumed for the remainder of the test. Pilot Test No. 3 will be approximately 48 hours in duration.

3.2.4 Pilot Test No. 4 - Concurrent Groundwater Extraction and Sandstone System Performance

Pilot Test No. 4 will evaluate the performance of the sandstone vapor extraction vent (SV1) with the benefit of groundwater extraction, and will evaluate the contaminant removal contribution from the dewatered sandstone. The groundwater pumps will be capable of pumping 7 gpm but WCFS does not expect the formation to sustain this rate. Based on previous pump tests and groundwater monitoring well development, WCFS estimates the pumping rate will be approximately 2 gpm. Groundwater extraction will be initiated concurrently in SV1 and SI1 prior to system start-up at a rate of 2.0 gpm from each well. Water levels in SV1, SI1 and PM probe SPM1 will be measured on an hourly basis. It is important to note that the actual pumping rate will depend on the amount of water the formation can yield. It is expected that 2.0 gpm from each well will result in a drawdown of over 10 feet in the pumping wells. If after 24 hours the drawdown in the pumping wells is less than 10 feet, the pumping rate will be increased to provide 10 feet of drawdown.

Once the appropriate pumping rate is determined, the well will be pumped for 24 hours. If after 24 hours the water level has not stabilized at 10 feet below the original level, pumping will continue until the water level stabilizes. Stabilization is defined as less than a 0.1-foot change in water level in SPM1 (the PM probe nearest to SV1) per hour. Once the water level has stabilized, the SVE system will be started. Groundwater extraction will continue throughout the test, and be stored in two 10,000-gallon tanks.

Pilot Test No. 4 will be similar to Pilot Test No. 3. Specifically, Pilot Test No. 4 will consist of three separate runs performed at the same vent operating pressures as the three runs of Pilot Test No. 3 (see Appendix D). The measurements to be taken during each run of Pilot Test No. 4 are identical to the measurements taken for the individual runs during Pilot Test

No. 3 (see Appendix D and Section 3.2.3). Optimal SV1 operating pressure will be determined based on the maximum subsurface pressure measurements made at SPM1, SPM2, and SI1. Groundwater extraction will be considered beneficial should it increase contaminant removal rates when compared with Pilot Test No. 3 results.

Three groundwater samples for laboratory analysis will also be collected during Pilot Test No. 4. and sent to an EG&G appointed laboratory. The first sample will be collected after groundwater has been pumped for a 12-hour period. The second sample will be collected following attainment of steady-state groundwater level conditions within PM probe SPM1. The third sample will be collected at the end of Pilot Test No. 4. VOC, metal, and radionuclide analytes for groundwater analysis are summarized in Appendix D.

For the three runs of Pilot Test No. 4, SV1 will be opened and AV1 will be closed. Groundwater will be extracted throughout the duration of Pilot Test No. 4 from both SV1 and SI1 at a rate such that the depth to groundwater within SV1 remains constant during SVE operation. Dilution air will be supplied to the system blowers as required. Individual runs of Pilot Test No. 4 will be conducted for a minimum of 16 hours following attainment of steady-state groundwater levels. Criteria for termination of Pilot Test No. 4 based on attainment of steady-state pressure distribution conditions are discussed in Section 3.2.3.

3.2.5 Pilot Test No. 5 - Concurrent Alluvium and Sandstone System Performance

Pilot Test No. 5 will evaluate the interaction between AV1 and SV1 when operated simultaneously and the resulting overall system performance. Pilot Test No. 5 will consist of a single run, during which AV1 will be operated at its optimal operating pressure (at the vent pressure resulting in greatest contaminant removal rate) as determined during Pilot Test No. 2. SV1 will also be operated at the optimal operating pressure as determined during Pilot Tests Nos. 3 and 4. Groundwater will be extracted from both SI1 and SV1 if it was determined to be either necessary during Pilot Test No. 3 or beneficial during Pilot Test No. 4. A pilot tube flow meter will be used to identify the relative percentage of soil gas

being extracted from SV1 and AV1. The calculated inlet flow rate will be divided based on these percentages for each extraction well.

For Pilot Test No. 5, both AV1 and SV1 will be opened. Groundwater may be extracted based on the results of Pilot Tests Nos. 3 and 4. Dilution air will be supplied to the system blowers as required. Pilot Test No. 5 will begin upon attainment of steady-state water level conditions (if applicable) as defined in Section 3.2.4. Pilot Test No. 5 will be conducted until steady-state pressure distribution conditions are achieved (minimum of 16 hours in duration) as defined in Sections 3.2.2 and 3.2.3.

Measurements to be taken during Pilot Test No. 5 are outlined in Appendix D. Initially, within 15 minutes of start-up, the parameters listed in Appendix D will be collected. Once the initial measurements are collected, the frequency at which these measurements are taken throughout the test is outlined in Appendix D.

3.2.6 Pilot Test No. 6 - Alluvium Passive Air Inlet Performance

Pilot Test No. 6 will evaluate the use of the alluvium air injection vent (AI1) as a passive air inlet and its influence on alluvium system performance. Pilot Test No. 6 will consist of a single run, during which AV1 will be operated at its optimal operating pressure as determined during Pilot Test No. 2. Measurements to be taken during Pilot Test No. 6 are identical to the measurements collected for Pilot Test No. 2 (see Appendix D). The use of AI1 as a passive air inlet will be considered beneficial should it increase contaminant removal rates when compared with Pilot Test No. 2 results. If the use of AI1 as a passive air inlet is determined to be advantageous, other alluvial PM probes may be employed as passive air inlets during the sustained operations period.

For Pilot Test No. 6, AV1 will be opened and SV1 will be closed. AI1 will be opened to the atmosphere by disconnecting the well head. Dilution air will be supplied to the system blowers as required. Pilot Test No. 6 will be run for a minimum of 16 hours. If steady-state

pressure distribution conditions are not achieved after 16 hours, the test will continue until steady-state conditions, as defined in Section 3.2.2 are achieved.

3.2.7 Pilot Test No. 7 - Sandstone Passive Air Inlet Performance

Pilot Test No. 7 will evaluate the use of the sandstone air injection vent (SI1) as a passive air inlet and its influence on sandstone system performance. Pilot Test No. 7 will consist of a single run, during which SV1 will be operated at its optimal operating pressure as determined during Pilot Tests Nos. 3 and 4. Groundwater will be extracted from SV1 and SI1 if it was determined to be either necessary during Pilot Test No. 3 or beneficial during Pilot Test No. 4. Measurements to be taken during Pilot Test No. 7 are identical to the measurements collected for Pilot Test Nos. 3 and 4 (see Appendix D). The use of SI1 as a passive air inlet will be considered beneficial should it increase contaminant removal rates when compared with Pilot Tests Nos. 3 and 4 results. If the use of SI1 as a passive air inlet is determined to be advantageous, other sandstone PM probes may be employed as passive air inlets during the sustained operations period.

For Pilot Test No. 7, SV1 will be opened and AV1 will be closed. SI1 will be opened to the atmosphere by disconnecting the well head. Dilution air will be supplied to the system blowers as required. Pilot Test No. 7 will be run for a minimum of 16 hours following attainment of steady-state pressure distribution conditions as defined in Section 3.2.3. If after 16 hours steady-state pressure distribution conditions have not been achieved, as defined in Section 3.2.3, the test will continue until steady-state conditions are established.

3.2.8 Pilot Test No. 8 - Alluvium Forced Air Inlet Performance

Pilot Test No. 8 will evaluate the use of the alluvium air injection vent (AI1) as a forced air inlet and its influence on alluvium system performance. Pilot Test No. 8 will consist of a single run, during which AV1 will be operated at its optimal operating pressure as determined during Pilot Test No. 2. Measurements to be taken during Pilot Test No. 8 are identical to

the measurements collected for Pilot Test No. 2 (see Appendix D). The use of AI1 as a forced air inlet will be considered beneficial should it increase contaminant removal rates when compared with Pilot Test No. 2 results.

For Pilot Test No. 8, AV1 will be opened, SV1 will be closed, and AI1 will be supplied a constant flow of air from blower B-600 (no greater than 50 percent of AV1's extracted air rate). Maximum AI1 air injection rate is the rate which maintains APM2's subsurface pressure at or below 0.1 inches of water vacuum pressure. To determine AI1's air flow rate, AI1 will be supplied air from blower B-600 at varying flow rates (in the range of 10 to 50 percent of AV1s extracted air rate) upon commencing Pilot Test No. 8, but prior to initiating measurements. Subsurface pressure measurements will then be taken at APM2 to monitor that injected air is being withdrawn at AV1. If the subsurface pressure at APM2 is less than 0.1 inches of water vacuum pressure, the air injection rate will be decreased until the subsurface pressure at APM2 is equal to or greater than 0.1 inches of water vacuum pressure. Once a suitable AI1 air flow rate has been determined, Pilot Test No. 8 measurements will begin. Dilution air will be supplied to the system blowers as required. Pilot Test No. 8 will be run until steady-state pressure distribution conditions are achieved (16 hour minimum duration) as defined in Section 3.2.2.

3.2.9 Pilot Test No. 9 - Sandstone Forced Air Inlet Performance

Pilot Test No. 9 will evaluate the use of the sandstone air injection vent (SI1) as a forced air inlet and its influence on sandstone system performance. Pilot Test No. 9 will consist of a single run, during which SV1 will be operated at its optimal operating pressure as determined during Pilot Tests Nos. 3 and 4. Groundwater will be extracted from SV1 and SI1 if it was determined to be either necessary during Pilot Test No. 3 or beneficial during Pilot Test No. 4. Measurements to be taken during Pilot Test No. 9 are identical to the measurements collected for Pilot Tests Nos. 3 and 4 (see Appendix D). The use of SI1 as a forced air inlet will be considered beneficial should it increase contaminant removal rates when compared with Pilot Tests Nos. 3 and 4 results.

For Pilot Test No. 9, SV1 will be opened, AV1 will be closed, and SI1 will be supplied a constant flow of air from blower B-600 (not greater than 50 percent of SV1's extracted air rate). Maximum SI1 air injection rate is the rate which maintains SPM2's subsurface pressure at 0.1 inches of water vacuum pressure. To determine SI1's air flow rate, SI1 will be supplied air from blower B-600 at varying flow rates (in the range of 10 to 50 percent of SV1s extracted air rate) upon commencing Pilot Test No. 9, but prior to initiating measurements. Subsurface pressure measurements will then be taken at SPM2 to monitor that injected air is being withdrawn at SV1. If the subsurface pressure at SPM2 is less than 0.1 inches of water vacuum pressure, the air injection rate will be decreased until the subsurface pressure at SPM2 is equal to or greater than 0.1 inches of water vacuum pressure. Once a suitable SI1 air flow rate has been determined, Pilot Test No. 9 measurements will begin. Dilution air will be supplied to the system blowers as necessary. Pilot Test No. 9 will begin once steady-state groundwater level conditions have been achieved, as defined in Section 3.2.4. Pilot Test No. 9 will be run until steady-state pressure distribution conditions have been established (16 hour duration) as defined in Section 3.2.3.

3.3 SUSTAINED OPERATION

After completion of the system operation and pilot tests, sustained operations of the mobile vapor extraction pilot unit may be conducted for the next six weeks. Sustained operations will be performed if the pilot tests indicate that VOCs are being recovered at a rate which equals or exceeds 1 pound of VOCs per 24-hour operating period.

During the sustained operations period, the system will operate continuously. The system will be configured to match the optimal conditions for both the alluvium and sandstone vents (both vents will operate during sustained operations) as determined during the pilot tests. The information gathered during the sustained operations period will be used to support the evaluation of the technology in the FS and to assess the benefit of IM/IRA operation. Of

particular importance will be the contaminant removal rate versus time, and the radius of influence. Measurements to be collected during sustained operations are outlined in Appendix D.

3.4 WASTE MANAGEMENT

Soil and groundwater are waste streams that occur during SVE operations. Soil is drummed according to Section 2.4, while groundwater is stored in two 10,000-gallon tanks. Water stored in these tanks is to be transported and disposed of by EG&G. The estimated capacity per test except for the sustained operation is based upon a range of 0.5 gpm to 2.0 gpm groundwater recharge rate. The following list is the estimated range of water production per test:

Test 1 - 0 gallons of water
Test 2 - 0 gallons of water
Test 3 - 0 gallons of water
Test 4 - 1,000 to 4,000 gallons of water
Test 5 - 1,000 to 4,000 gallons of water
Test 6 - 0 gallons of water
Test 7 - 1,000 to 4,000 gallons of water
Test 8 - 0 gallons of water
Test 9 - 1,000 to 4,000 gallons of water

Total of 4,000 to 16,000 gallons of extracted groundwater will be generated over the length of the tests.

The extracted groundwater will be stored in double-wall storage tanks prior to final disposition at either the Building 891, Building 374 or OU-2 Trailer T700 Surface Water Treatment facilities.

3.5 SAMPLING AND TESTING

This section will describe the sampling procedures for the different media. Soil sampling locations and frequency are summarized in Table 3-1.

3.5.1 Extracted Soil Gas

Soil gas is collected and monitored throughout each test and the sustained operation. Soil gas is collected from four different locations on the SVE unit. These locations are:

- The appropriate vapor extraction well head (AV1 and SV1)
- After the primary blower (B-300)
- After the first GAC column (D-400)
- After the second GAC column (D-410)

Soil Gas Collection

Soil gas will be collected via sampling ports located throughout the soil vapor process. Each port within the trailer will have a separate teflon line running from the sample port to the centrally located gas sampling cabinet. Ports AVI and SVI are outside of the trailer on the extraction lines. A portable gas sampling pump and teflon tubing will be used for the exterior locations. For each pilot test, the sample ports in the gas sampling cabinet are sampled using the following procedure:

- Valve the sample train and turn on the gas sampling pump

- Prepare the SUMMA canister for sampling (e.g., measure and record vacuum, etc.) in accordance with laboratory supplied procedures

- Flush system by allowing the pump to run for 2 minutes without opening the sample port
- Flush the sample port with sample for 15-30 seconds
- Obtain an HNU reading
- Close the sample port
- Connect SUMMA canister to the sample port
- Open the sample port and collect the sample
- Close the sample port and disconnect the SUMMA canister
- Complete SUMMA canister forms in accordance with laboratory supplied procedures
- Open the next sample line to be sampled and repeat the previous steps until all sample lines have been sampled

To collect soil gas samples from wells AV1 and/or SV1, the following sampling procedure is used:

- Prepare the SUMMA canister for sampling (e.g., measure vacuum, etc.) in accordance with laboratory supplied procedures
- Connect the portable sample pump to the sampling point on the AV1 extraction piping

- Open sampling point, turn on pump and purge line
- Obtain an HNU reading
- Connect the pump to the SUMMA canister
- Fill the SUMMA canister
- Close and disconnect the SUMMA canister
- Close the sample port
- Disconnect pump and close sampling point
- Complete SUMMA canister forms in accordance with laboratory supplied procedures
- Repeat above steps for SV1 sampling point

Refer to Section 3.2 and Appendix D for the schedule associated with soil gas sampling. Samples collected from the sample port after the second GAC unit (D-410) will be analyzed using the EPA CLP method and validation. All other soil gas analyses require certificate of analysis (i.e., CLP validation is not required).

Soil Gas Monitoring

Soil gas will be monitored with an HNu or equivalent at the sample port in the gas sampling cabinet or well head. As described in the soil gas sampling procedures above, an HNu reading is taken before each sample is collected. An Hnu fitted with a "T" is used to take

a real time reading on the sample line. This process is repeated until all sample lines have been monitored.

Subsurface soil gas pressure will be monitored according to the schedule presented in Appendix D for each test. This pressure measurement will be taken by hand using a hand held digital manometer. The following procedure will be followed for subsurface pressure monitoring at all sandstone/alluvial pressure monitoring probes:

- Zero manometer to atmospheric pressure.
- Place manometer on nipple located at the top of each pressure monitoring probe.
- Open stop cock and let manometer equalize for approximately 30 seconds.
- Take reading and close stop cock.
- Repeat procedure for the remaining pressure monitoring probes.

3.5.2 Extracted Groundwater

Groundwater will be collected and monitored during tests where the sandstone vent is in operation. Groundwater is extracted and monitored from sandstone wells SV1 and SI1 through the use of two submersible pumps. The following section describes how groundwater is collected and how monitoring of groundwater will occur.

Groundwater Collection

Groundwater evacuation is regulated in SV1 and SI1 through the use of a globe valve located at each well head. Once the determined flow is set, groundwater collection from SV1 and SI1 is as follows:

- Open sample port located on the extraction line from the submersible pumps to the 10,000-gallon storage tanks.
- Fill one 125 ml polyethylene rad screen bottle.
- Fill four 40-ml glass VOA vials.
- Fill one 1-L polyethylene bottle for metals analysis.
- Fill three 1-gallon bottles for total rads analysis.
- Fill one 250 ml amber glass bottle for tritium analysis.
- Close sample port from wells.

Sampling equipment will be thoroughly decontaminated before each sample collection in accordance with SOP FO.03, General Equipment Decontamination.

The samples will be containerized, preserved, handled and shipped in accordance with SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples. All decontamination and sampling activities will be documented by the sampling personnel using the forms required by the SOPs and black indelible permanent ink. Data may also be

recorded in a bound weatherproof field log book, if desired. The analytical parameters, required sample containers, and preservation are described in Table 3-2.

Refer to Sections 3.2.3, 3.2.4, 3.2.5, 3.2.7, 3.2.9, and Table 3-3 for frequency of sampling.

TABLE 3-2

ANALYTICAL PARAMETERS, ANALYTICAL METHODS, SAMPLE CONTAINERS,SAMPLE PRESERVATION,AND SAMPLE HOLDING TIMES FOR ANALYTICAL PARAMETERS FOR THE ROCKY FLATS OU-2 SOIL VAPOR EXTRACTION PROJECT

Parameter	EPA Analysis Method or Analysis Reference[a]	Container	Preservative	Holding Time
Soil Samples				
Organic Compounds:				
Volatile Organics	SW 846 EPA Method 8240	Stainless-steel VOC liner	Cool, 4°C	7 days
Inorganic Analytes:				
Radionuclides Gross Alpha, Gross Beta Strontium 89, 90 Plutonium 239, 240 Americium 241 Total Uranium 233/234, 235, 238 Tritium	see GRRASP	1 x 500 mL wide-mouth glass jar	N/A	45 days
Water Samples				
Organic Compounds:				
Volatile Organics	EPA-CLP-TCL *except chloroform and tetrachloroethene, use EPA 524.2	4 x 40-mL glass VOA vials with teflon line septum lids	Cool, 4°C[b] with HCl to pH <2	7 days 14 days
Inorganic Analytes:				
Metals and Other Metals	EPA-CLP-TAL plus Mo, Sr, Cs, Li, Sn	1 x 1-L polyethylene bottle	Nitric acid pH <2; Cool, 4 °C	180 days[c]
Radionuclides Gross Alpha, Gross Beta Strontium 89, 90 Plutonium 239, 240 Americium 241 Total Uranium 233/234, 235, 238	see GRRASP	3 x 1-gal polyethylene bottle	Nitric acid pH <2	180 days
Tritium		1 x 250 ml amber glass bottle	N/A	180 days

TABLE 3-2 (continued)

Parameter	EPA Analysis Method or Analysis Reference[a]	Container	Preservative	Holding Time
Soil Gas				
Organic Compounds:				
Volatile Organics	EPA TO14	1 < Stainless Steel SUMMA canister	N/A	N/A

[a] EPA-CLP for Organics - U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, 2/88 or latest version.
EPA-CLP for Inorganics - U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, 7/88 or latest version.
GRRASP - General Radiochemistry and Routine Analytical Services Protocol. ER Program, Rocky Flats Plant, Golden, CO. August.
EPA. 1984. Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air. EPA/600/4-84/041

[b] Add 0.008 percent sodium thiosulfate (NA_2,S_2,O_3) in the presence of >0.2 ppm residual chlorine.

[c] Holding time for mercury is 28 days.

TABLE 3-3

OU-2 SUBSURFACE IM/IRA SVE
SAMPLES FOR OFF-SITE LABORATORY ANALYSIS

Matrix	Site #	Sample Criteria	Total #	Sample Type (see below for related analysis methods)
Soil	AV1	3 Highest PID readings or: 6 feet bgs, mid boring and bottom of boring	3	VOC[1]
Soil	AV1	5 feet, 10 feet and 15 feet bgs	3	Radionuclides
Soil	APM1	Highest PID reading or midpoint of boring	1	VOC[1]
Soil	APM2	Highest PID reading or midpoint of boring	1	VOC[1]
Soil	APM3	Highest PID reading or midpoint of boring	1	VOC[1]
Soil	SV1	3 Highest PID readings or: 6 feet bgs, mid boring and bottom of boring	3	VOC[1]
Soil	SV1	5 feet, 10 feet and 15 feet bgs	3	Radionuclides
Soil	SPM1	Highest PID reading or midpoint of boring	1	VOC[1]
Soil	SPM2	Highest PID reading or midpoint of boring	1	VOC[1]
Water	10,000-gallon tanks	As tanks become full	2	VOC[2] Metals and Radionuclides
Water	Sample port on extraction line to the tank	After 12 hours of groundwater pumping	1[3]	VOC[2], Metals and Radionuclides
Water	Sample port on extraction line to the tank	At steady-state groundwater level conditions within PM probe SPM1	1[3]	VOC[2], Metals and Radionuclides
Water	Sample port on extraction line to the tank	At end of Pilot Test No. 4	1[3]	VOC[2], Metals and Radionuclides
Soil Gas	MKUPAU		18	VOC[3]
Soil Gas	AVI	Per Appendix D	21	VOC[3]
Soil Gas	SVI	Per Appendix D	40	VOC[3]
Soil Gas	B-300	Per Appendix D	57	VOC[3]
Soil Gas	GAC1	Per Appendix D	57	VOC[3]
Soil Gas	GAC2	Per Appendix D	57	VOC[3]

- Field QA/QC (duplicates and equipment rinsates) samples are not indicated in the "total #" column. However, the field QA/QC samples will be collected and analyzed at a frequency of 1 in 20 or one per sample day, whichever is more frequent.

- Trip blanks will be shipped with associated aqueous VOC samples. Trip blanks will be analyzed for VOC only in the event of sample bottle breakage during shipment.

- All samples will be rad screened prior to shipment off site.

bgs = Below ground surface
VOC[1] = SW-846 VOC Method 8240.
VOC[2] = CLP-TCL VOCs (chloroform and tetrachloroethane chemical analysis will require EPA Method 502.2 to obtain the PQLs as required in the work plan).
VOC[3] = EPA TO14
Metals = CLP-TAL Metals plus 5 non-TAL metals: Mo, Sr, Cs, Li, Sn.
Radionuclides = Gross Alpha, Gross Beta, Strontium 89, 90, Plutonium 239, 240, Americium 241, Tritium, total Uranium 233/234, 235, 238.
1[3] = Additional samples possible from Pilot Tests Nos. 3, 4, 7, and 9.

Groundwater Monitoring

Groundwater monitoring consists of taking groundwater level measurements. WCFS is proposing to install two piezometers, one in SV1 and one in SI1. These piezometers are designed to use a pressure transducer placed 5 feet off the bottom of the well. This pressure transducer will record an initial value based on where the water column is in the well at the beginning of the test. Based on whether water level rises or falls, the pressure transducer will produce a reading based upon the weight of the water column. This system is installed so the well can be sealed preventing the introduction of outside air and the reduction of the system vacuum. Refer to Sections 3.2.3, 3.2.4, 3.2.5, 3.2.7, and 3.2.9 for frequency of measurements.

3.5.3 10,000-Gallon Tank Sample Collection

The 10,000-gallon waste water tanks will be sampled as they become full. Sampling environmental liquids from the 10,000-gallon liquid storage tanks will be performed in accordance with SOP FO.20, Sampling of Liquids and Solids From Environmental Materials Containers; Section 5.0, Sampling Procedures; and Section 5.2.4, Sampling Liquids. This SOP describes the responsibilities and qualifications of personnel performing the sampling, health and safety considerations, sampling equipment and procedures, and documentation of sampling events.

Sampling equipment will be thoroughly decontaminated before each sample collection in accordance with SOP FO.03, General Equipment Decontamination. Prior to sampling, an appointed Health and Safety representative will open the tank and monitor the tank interior with an HNu. Samples from the 10,000-gallon liquid storage tanks will be collected using a bottom-filling bailer. The samples will be containerized, preserved, handled and shipped in accordance with SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples. All decontamination and sampling activities will be documented by the sampling personnel using the forms required by the SOPs and black indelible permanent ink.

Data may also be recorded in a bound weatherproof field log book, if desired. The analytical parameters, required sample containers, and preservation are described in Table 3-2.

3.5.4 Soil Sampling

The samples will be collected using a split-spoon auger. One stainless-steel VOC liner will be used for each split spoon coring run. Each liner will be 6 inches in length, 2.5 inches in outer diameter, and 2.4 inches in inner diameter. Hollow auger sampling will be performed in accordance with SOP GT.02, Drilling and Sampling using Hollow-Stem Auger Techniques.

The sample will be brought to the surface and removed by opening the sampler along its length or by using an extruder. The sample liners will be screened for organic vapors using a detector such as HNu (RFP SOP No. FO.15) and kept until sampling is complete.

For soil samples collected during the advancement of soil borings for extraction vents for the alluvial wells, the three samples that displayed the highest organic vapor readings will be analyzed for VOCs. If no organic vapors are detected during field screening, samples will be collected from 6 feet below ground surface (bgs) (assumed total depth of disposal in trench T-4), from the bottom of the borehole and from the midpoint of the boring as shown in Table 2-1.

For soil samples collected during the advancement of soil borings for extraction vents for the bedrock wells, the one sample that displays the highest organic vapor readings will be analyzed for VOCs. The two samples from the bedrock layer that display the highest organic vapor readings will be analyzed for VOCs.

For soil samples collected during the advancement of soil borings associated with the installation of PM probes, the sample displaying the highest organic vapor reading will be analyzed for VOCs. If no organic vapors are detected during field screening, the sample

collected from the midpoint of the boring will be analyzed for VOCs as indicated in Table 2-1.

In addition, during the advancement of soil borings for the extraction wells, soil samples will be collected at 5, 10, and 15 feet bgs. Each sample will be composited and analyzed for radionuclides, as indicated in Table 2-1. The compositing procedure is described below.

Compositing of samples will be done by emptying the sample container into a large stainless-steel bowl or pan and stirring by using a stainless-steel scoop or spoon to thoroughly mix the sample. The soil will be scraped from the sides, corners, and bottom of the pan, rolled to the center of the pan, and mixed. The sample will then be quartered and moved to the four corners of the mixing pan. Each quarter of the sample will then be mixed individually. Each quarter will then be rolled to the center of the mixing pan and the entire sample mixed together. This procedure will be repeated as necessary to provide a homogeneous sample before being placed in the sample container.

The samples will be containerized, preserved, handled and shipped in accordance with SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples. All decontamination and sampling activities will be documented by the sampling personnel using the forms required by the SOPs and black indelible permanent ink. Data may also be recorded in a bound weatherproof field log book, if desired. The analytical parameters, required sample containers, and preservation are described in Table 3-2.

3.5.5 GAC Unit Sampling

The GAC units will be removing contaminants from the extracted soil gas and will have the potential of containing radionuclide-contaminated particles. Therefore, the GAC units will need to be sampled prior to shipment off site for disposal. The Final OU-2 Subsurface IM/IRA Scientific Notebook Plan details the sampling and analysis procedures required.

3.5.6 Operations

Operation of the mobile SVE includes the sampling of different media and the collection of system operational parameters. System operational parameters include pressure, flow rate, temperature, relative humidity, radiation, and GAC capacity estimation. This section describes how each of these parameters is collected and determined.

Pressure

Pressure is monitored from various points throughout the mobile unit. These monitoring points are:

- AV1
- AI1
- APM1
- APM2
- APM3
- SV1
- SI1
- SPM1
- SPM2
- Dilution air line (PI-100)
- Vapor manifold (PI-110)
- After blower B-300 (PI-300)
- After GAC D-400 (PI-400)
- After GAC D-410 (PI-410)
- Stack (PI-500)
- Before and after each HEPA filters (PI-200 and PI-210, respectively)

Pressure measurements made at the well heads and monitoring probes are done manually with a hand held manometer. Pressure measurements made within the mobile SVE trailer are automatically collected and sent to a datalogger for access with a computer.

Flow Rate

Flow rates are recorded automatically from the makeup air stream and from the stack. Based upon this data, the flow in each well is calculated by:

$$Flow_{stack} = Flow_{makeup\ air} + Flow_{wells}$$

When both wells are operating concurrently, a pitot tube is installed in each well. The pitot tube will measure the differential pressure in the air stream between the static and total pressure. From this value, an air stream velocity is calculated. Once the velocity of the air stream is known, the relative flow rate is calculated by multiplying the air velocity by the cross sectional area of the pipe. Using the relative flow rates calculated for each extraction well, the flow rate from the wells as calculated above will be divided to provide the flowrate estimated from each well.

Temperature

Temperature measurements are to be monitored at four locations in the mobile SVE unit. These four locations are:

- Dilution air line (TI-100)
- Vapor manifold (TI-110)
- After blower B-300 (TI-300)
- At the stack (TI-500)

These measurements are all automatically collected and sent to the system datalogger for access via a computer.

Relative Humidity

Relative humidity measurements are to be monitored at three locations in the mobile SVE system. These three locations are:

- Dilution air stream (MI-100)
- Vapor manifold (MI-110)
- After blower B-300 (MI-300)

These measurements are all automatically collected and sent to the system datalogger for access via a computer.

Radiation

This subsection describes the procedures that will be used to verify that the treated soil gas discharged from the pilot unit is free of radionuclide-contaminated particulates. A SAMM is used to monitor for radiation.

EG&G Radiation Detection Engineering will monitor and oversee the operation of the SAAM. If an alarm is tripped, EG&G Radiation Detection Engineering will evaluate and determine if the alarm was caused by short-lived species (e.g., radon decay products) or transuranic radionuclide contamination (e.g., plutonium, americium, and uranium, etc.). Continued Pilot Testing will then be evaluated.

GAC Capacity Estimation

The performance of the vapor-phase GAC units will be estimated based on the results obtained throughout the duration of all nine system pilot tests. System variables, such as relative humidity and temperature of the extracted vapor stream, will affect the performance of the GAC units. Contaminant mass removal rates will determine the mass loading rate. GAC isotherms for the compounds extracted will be used to estimate the carbon unit lifetime.

In addition to computing an estimate of GAC unit lifetime, GAC unit lifetime will also be determined by direct measurement. The contaminant concentration data obtained from sample ports SP-1, SP-2, and SP-3 (B-300 Out, GAC-1 Out, and GAC-2 Out, respectively) will be analyzed for VOC breakthrough. Breakthrough will be defined as the time when the VOC concentration exiting GAC-1 (GAC-1 Out) is 95 percent of the VOC concentration entering GAC-1 (B-300 Out) or when any VOCs are detected exiting GAC-2 (GAC-2 Out). From this information, the capacity of GAC D-400 will be estimated (i.e., the total amount of contaminant the unit has adsorbed). When breakthrough occurs, GAC D-400 will be removed from the system and replaced by a new lead GAC unit. GAC D-410 will be moved to become the lead GAC unit if an estimated 50 percent of its capacity has been used at the time of the lead GAC unit replacement. The new GAC unit will then be installed as the polishing GAC unit. If greater than 50 percent capacity of GAC D-410 has been used, the new GAC unit will become the lead unit and GAC D-410 will remain as the polishing unit. Therefore the polishing GAC unit will always maintain a minimum of 50 percent of unused adsorption capacity.

3.6 SAMPLE HANDLING

Sample handling and shipping will be in accordance with SOP FO.13, Containerization, Preserving, Handling and Shipping of Soil, Water and Soil Gas Samples. Sample preservation requirements and holding times are provided in Table 3-2.

Rad screen samples should be shipped priority overnight on the same day as the sampling event to a designated laboratory assigned by EG&G Sample Management. Shipment of the rad screen sample(s) must be in accordance with Department of Transportation (DOT) regulations. Rad screen results should be sent by facsimile from the lab the following day to the Designated Subcontractor (DSC) sample manager.

If the rad screen result is "N/A" or less than (<) 50 picocuries/liter (pCi/L), radionuclide samples can be shipped to a non-licensed (NRC) laboratory. If rad screen results are greater than (>) 50 pCi/L, the DSC will contact EG&G Sample Management for instructions and a lab assignment.

The radionuclide samples will be shipped to an approved radiochemistry lab, unless rad screen results are greater than 2,000 ρCi/L for specific activity of the sample, or if the total activity of the sample is greater than 0.01 microcurie (μCi). If the rad screen results are greater than these levels, the DSC will contact EG&G Sample Management for instructions and a lab assignment.

When radionuclide samples are shipped, use Federal Express Economy 2-day service, if possible. The charge number for analytical costs should be obtained from EG&G Sample Management and included on the COC.

3.7 QA/QC REQUIREMENTS

Samples will be analyzed in accordance with SOP GT.19, Rev. 2 and Appendix E (Guidance for Sampling and Analysis). Table 3-4 lists the soil and water QA/QC criteria. Table 3-5 lists the gaseous QC criteria. The QA Manager will be responsible for verifying that required field measurements are obtained. The required measurements are listed in the tables found in Appendix D. The QA Manager will inform the Field Engineer of any omission(s).

3.8 DATA MANAGEMENT

The DSC provides timely entry, editing, and delivery of all sample collection information generated during sampling events at the decontamination facilities. The information will be provided in electronic format in accordance with SOP FO.14, Field Data Management, and EG&G requirements and programs (e.g., Datacap). Both sample collection and tracking information will be delivered to the Rocky Flats Environmental Data system (RFEDS) on a weekly basis. The RFEDS is used to track, store, and retrieve project data. The sample collection information to be provided includes sample number, volume collected or volume of container, sampler's name, sampling date, analysis parameter, and COC number in accordance with SOP FO.14, Field Data Management. The DSC will also back-up all electronic files daily, and file all hardcopy data forms and field notes, etc. Data Management is discussed in detail in the Final OU-2 IM/IRA Data Management Plan (EG&G, 1993).

TABLE 3-4

QA/QC CRITERIA FOR SOIL AND WATER SAMPLES

Activity	Frequency
Field Duplicate	1 in 20
Trip Blank	1 per cooler containing aqueous VOC samples
Equipment Rinsate	1 in 20 or once per sample day, whichever is more frequent

TABLE 3-5
QC REQUIREMENTS FOR EXTRACTED SOIL GAS

Activity	Frequency
Make Up Air	Pilot Run
Field Duplicate	1/10

4.0 PROJECT MANAGEMENT PLAN

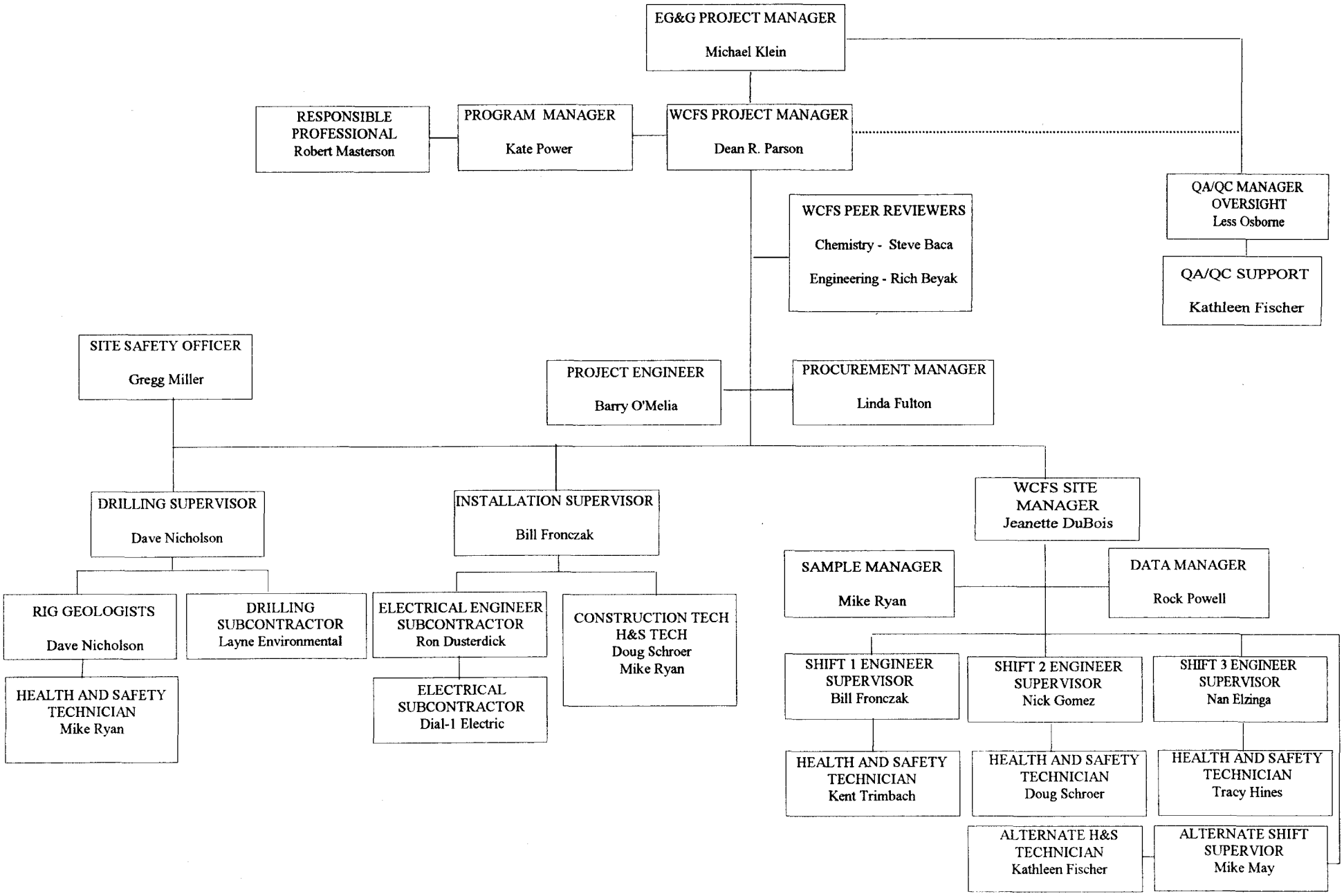
This section presents the Project Management Plan (PMP) for the OU-2 IM/IRA Soil Vapor Extraction Pilot Program. The PMP includes the project organization and responsibility matrix, a description of the work breakdown structure (WBS), and the project management control system.

4.1 PROJECT ORGANIZATION

Key personnel of the proposed field team are presented in Figure 4-1. The field team is comprised of the following functional positions and individuals.

- Administrative Project Manager - Dean Parson
- Soil Vapor Extraction Project Engineer - Barry O'Melia
- Site Manager - Jeanette DuBois
- Installation Supervisor - Bill Fronczak
- Site Safety Officer (SSO) - Gregg Miller
- Drilling Supervisor and Rig Geologist - Dave Nicholson
- Rig Health and Safety Technician (HST) - Mike Ryan
- Operation Shift Supervisors - Nick Gomez, Nan Elzinga, and Bill Fronczak

Figure 4-1
OU-2 SOIL VAPOR EXTRACTION PILOT TEST
PROJECT ORGANIZATION



(4045-110-0110-5133)(SVESML.DRW)

- Shift Health and Safety Technicians - Doug Schroer, Kent Trimbach, and Tracy Hines
- Sample and Data Manager - Mike Ryan
- QA/QC Manager - Kathleen Fischer

The responsibilities and duties of the key functional positions are described in Section 4.2.1.

4.2 WORK BREAKDOWN STRUCTURE

The WBS is a work structure, not an organizational structure. It includes a description of the work to be performed by all participants, and cost, schedule, and milestone information.

The field program has been subdivided into six activities for the OU-2 Soil Vapor Extraction Pilot Test. These activities are used for scheduling and organizational control under the WBS. The six activities are as follows:

- Drilling, Soil and Rock Sampling, and SVE Well Installation
- SVE Unit Installation
- SVE Pilot Testing
- Sample and Data Management
- Field Health and Safety
- Field Management
- Project Management

4.2.1 Personnel Responsibilities

The following sections describe responsibilities and work by activity for each key member of the field team.

4.2.1.1 Drilling, Soil and Rock Sampling, and SVE Well Installation

Drilling Supervisor

The drilling supervisor's duties and responsibilities include:

- Supervise and coordinate drilling operations of drill rigs.
- Meet with the site manager daily to confirm that project objectives are being achieved in a time and cost efficient manner.
- Interpret lithologic and geophysical logging results to identify appropriate SVE well screen intervals.
- Check that isolation casings and monitoring wells are installed correctly.

Rig Geologist

The rig geologist is responsible for the overall operation of the drill rig field team. The rig geologist's duties and responsibilities include:

- Meet daily with the driller to brief him on the activities proposed for the day.
- Meet with the sample manager daily to obtain information on the sampling and QA/QC requirements.

- Fill out appropriate SOP forms including:

  - Heavy Equipment Decontamination/Wash Checklist and Record (Form FO.4A)
  - Start Drum Field Log Form (Form FO.10A)
  - Start Borehole Log (Form GT.1A)
  - Hollow-Stem Auger Drilling Field Activities Report (Form GT.2A)
  - Surface Casing Installation Field Activities Report (Form GT.3A)
  - Borehole Abandonment Field Activities Report (Form GT.5A)
  - Groundwater Monitoring Well and Piezometer Report (Form GT.6A)

- Check that the driller and driller's helper load appropriate equipment such as drums; decontaminated, appropriately-sized downhole equipment; decontaminated, appropriately-sized well materials (e.g., pipe, filter pack, bentonite pellets, grout, sand bailer, surface casing, etc.).

- Confirm that all downhole and/or sampling equipment has been properly decontaminated prior to drilling and/or sampling.

- Document pertinent information including significant events, observations and measurements during field investigations.

- Check that all drilling and sampling is conducted according to the applicable SOPs and OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993).

- Check that isolation casings and monitoring wells are installed according to the applicable SOPs and OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993).

- Check that all monitoring wells are properly labeled.

- Relinquish samples to the sample manager at the end of the day.

Health and Safety Technician (HST)

The HST is responsible for the overall safety of the drill rig field team. The duties and responsibilities include:

- Meet with the SSO daily prior to field activities and fill out a health and safety checklist.

- Document health and safety information including instrument readings, significant events, and observations.

- Obtain sampling equipment daily.

- Confirm calibrations of monitoring equipment and log results.

- Fill out appropriate SOP forms including:

  - Verification of Organic Vapor Monitoring Results (Form FO.8A)
  - Record of Drilling Fluids and Cutting (Form FO.8B)
  - Sample Monitoring portion of Radiological Measurements Form (Form FO.16A)

- Start chain of custody (COC) form for sampling operations.

- Set up an exclusion zone with cones (30-foot radius from borehole).

- Monitor samples, equipment, and personnel for radionuclides and organics according to the applicable SOPs and/or Environmental Management Radiological Guidelines (EMRGs).

- Interface with the SSO by radio.

- Assist the rig geologist with sampling operations.

- Observe/monitor the crew for health and safety needs (health and safety infractions, heat stress, etc.).

- Monitor each member of the field team for compliance with the project-specific health and safety plan and for other health and safety needs, and document this information.

- Initiate the appropriate paperwork for health and safety incidents and infractions.

4.2.1.2 SVE Unit Installation

Installation Supervisor

The installation supervisor is responsible for all personnel and equipment required to install and prepare the SVE Unit for operation during the SVE Pilot Testing Field Program. Specific activities include:

- Document all inspections and testing.

- Document all equipment and materials received so that they meet specifications and match purchase orders.

- Meet with site manager daily to discuss various installation and operational activities.

- Meet with project engineer and electrical engineer to discuss installation and preparation activities.

- Organize and direct crew on daily activities.

- Check that appropriate equipment is loaded each day.

- Document pertinent information including significant events and observations during installation procedures.

- Check that all installation activities are performed in accordance with applicable SOPs and the OU-2 Subsurface IM/IRA Pilot Test Plan (EG&G 1993).

- Document construction schedule.

4.2.1.3 SVE Pilot Testing

WCFS Shift Supervisor

The shift supervisor's duties and responsibilities include:

- Supervise and coordinate testing operations associated with the SVE Unit.

- Meet with site manager and verify sample schedule and operational parameters.

- Coordinate sampling and monitoring.

- Communicate with pilot test manager and project manager concerning operations and findings.

- Fill out appropriate SOP forms and documentation.

- Document findings, significant events, and any measurements.

- Check that all operations and sampling is conducted according to applicable SOP and the Implementation Plan.

- Relinquish all samples and information to the sample/data manager.

Shift Health and Safety Technician (HST)

The HST is responsible for the overall safety of the SVE Pilot Test field team. The duties and responsibilities include:

- Document health and safety information including instrument readings, significant events, and observations.

- Obtain sampling equipment daily.

- Confirm calibrations of monitoring equipment and log results.

- Fill out appropriate SOP forms including:

  - Verification of Organic Vapor Monitoring Results (Form FO.8A)

- Sample Monitoring portion of Radiological Measurements Form (Form FO.16A)

- Start COC form for sampling operations.

- Set up an exclusion zone with cones.

- Monitor samples, equipment, and personnel for radionuclides and organics according to the applicable SOPs and/or EMRGs.

- Observe/monitor the crew for health and safety needs (health and safety infractions, heat stress, etc.).

- Monitor each member of the field team for compliance with the project-specific health and safety plan and for other health and safety needs, and document this information.

- Initiate the appropriate paperwork for health and safety incidents and infractions.

4.2.1.4 Sample and Data Management

Sample Manager

The sample manager's duties and responsibilities include:

- Document all inspections and testing.

- Document all equipment and materials received so that they meet specifications and match purchase orders.

- Meet with the site manager daily to obtain sample requirements including QA/QC requirements.
- Fill out appropriate SOP forms.
- Fill out COC forms.
- Decontaminate sample coolers.
- Prepare decontaminated sample coolers with the appropriate sample liners, sample jars and blue ice prior to daily field activities.
- Meet and coordinate daily activities with the data manager.
- Assist the data manager in maintaining a sample tracking database.
- Maintain a daily log of sample management activities.
- Record dates, times and pertinent data of important telephone conversations with laboratories or EG&G personnel concerning sample information.
- Check that samples shipped off site meet DOT requirements.
- Secure and preserve collected samples until shipment.
- Check sample labels to make sure they contain the proper information and that they are consistent with the corresponding COC.
- Package sample jars and containers that will be shipped to the laboratory.

- Properly label the sample coolers according to environmental sample requirements prior to laboratory shipment.

- Deliver sample coolers to the courier.

- Interface with the laboratory:

  - Notify the laboratory of samples being shipped
  - Verify arrival of samples and that holding times are met
  - Conduct sample tracking

- Receive residual samples from analytical labs.

- Provide for storage and disposal of residual samples in accordance with SOPs.

- Inventory sampling equipment and supplies (including sample bottles, labels, blue ice, coolers, etc.), and order as necessary.

Data Manager

The data manager's duties and responsibilities include:

- Print out sample labels.

- Meet with the rig geologist daily to distribute sample labels.

- Fill out appropriate SOP forms including:

  - Rocky Flats Environmental Data System Field Data Transmittal Form (Form FO.14A)

- Input boring, well installation and sample information from field forms into RFEDS database.
- Check that QC of the RFEDS input information is conducted.
- Print hard copy of RFEDS and bind in chronological order.
- Backup information on diskette and tape daily.
- Download RFEDS database and deliver to EG&G weekly.
- Input boring logs into Geobase (logger) borehole program.
- Confirm that QC of the Geobase input information is conducted.
- Print hard copy of Geobase and bind in chronological order.
- Backup information on diskette and tape daily.
- Download Geobase to EG&G.
- Provide daily tracking of waste generated during field operations.
- Download waste tracking information.
- Oversee the data input clerk.

4.2.1.5 Field Health and Safety Management

SITE SAFETY OFFICER (SSO)

The site safety officer's duties and responsibilities include:

- Be on site during field work as appropriate.
- Direct on-site health and safety activities.
- Assist the project manager in all aspects of implementing the health and safety plan.
- Initiate appropriate revisions to the health and safety plan.
- Confirm that all field personnel have read and understand the project health and safety plan.
- Present a site health and safety briefing to new site personnel and visitors as needed.
- Conduct health and safety briefings with the field crews to review and update health and safety requirements.
- Oversee and train the health and safety technicians on the proper use of on-site health and safety equipment and documentation.
- Perform health and safety audits, and document all health and safety infractions and incidents.

- Check specifications, coordinate maintenance and ensure daily/regular calibration of health and safety equipment.

- Fill out appropriate SOP forms including:

  - Calibration Record (Form FO.15A)
  - Work area monitoring portion of the Radiological Measurements Form (Form FO.16A)

- Implement emergency procedures as required.

- Maintain files documenting personnel training qualifications:

  - Respirator fit tests
  - Medical monitoring documentation
  - Radiological training documentation

- Administer fit tests to personnel as needed.

- Maintain a daily log of on-site health and safety information including a daily health and safety checklist.

- Check that all on-site visitors have proper health and safety documents and personal protective equipment (PPE).

- Interface with RFP health and safety personnel.

- Authorize the suspension of field activities if the health and safety of personnel is endangered.

- Authorize the temporary suspension of an individual from field activities for infractions of the health and safety plan.
- Calibrate, source check, and maintain all radiation instrumentation.
- Obtain radiological work permits and post radiation signage (if needed).
- Implement and enforce the EMRGs.
- Confirm all radiation readings that are greater than 250 cpm on equipment or personnel.
- Perform daily, weekly and monthly radiation surveys of equipment and work areas as needed.
- Screen equipment off of the Main Decontamination Facility (MDF).
- Perform equipment release surveys.
- Document all radiation surveys.
- Scale and count all radiological smears collected in the field.
- Conduct daily QA checks of all field radiation monitoring documentation.

4.2.1.6 Field Management

Project Engineer

The project engineer has responsibility for technical aspects of the SVE Pilot Test field program. This position is necessary because the field investigation program is a focused program designed to incorporate an observational approach during evaluation of results as each field component is completed. The project task manager's responsibilities include:

- Manage subcontractors and shift personnel during SVE operations.
- Maintain schedule and technical quality.
- Interface with EG&G personnel.
- Review WCFS, subcontractor, and other direct cost (ODC) charges.
- Report weekly progress.
- Make on-site decision to support the observational approach of the field program.
- Assist the shift supervisors with technical issues.

Site Manager

The site manager has the responsibility for day to day logistics of the field investigation program. The site manager's duties and responsibilities include:

- Brief the rig geologists or other field team leaders daily prior to field work.

- Meet with the site safety officer daily and ensure that safety and equipment requirements are met.

- Generate weekly progress reports including information regarding number of wells completed; number of samples collected; results of field screening of samples; operational information; problems encountered and solutions.

- Interface with the EG&G project manager.

- Interface with the WCFS pilot test manager.

- Coordinate with the appropriate facility operations personnel, agencies, and subcontractors.

- Approve daily drilling contractor charges.

- Check project data sheets prior to submitting to the WCFS Pilot Test Manager.

- Initiate document change notices when it is necessary to deviate from the project control documents.

- Maintain a daily log of all personnel and visitors entering and exiting field areas.

- Maintain project field files.

- Maintain a log of field books.

- Maintain a log of daily activities including logs of telephone conversations.

4.2.1.7 Project Management

The project management staff consists of the personnel necessary to control the administrative and contractual day-to-day operations of the OU-2 project. The duties and responsibilities of the project management staff are outlined below.

Responsible Professional - Robert Masterson

The Responsible Professional (RP) is responsible for ensuring that WCFS completes the proposed scope of work according to EG&G/DOE and contract requirements, including work quality and compliance with budget and schedule requirements. The RP provides strategic direction during the project, oversees work and deliverables, and ensures that the WCFS peer review and QA/QC functions are conducted. He also maintains communications with EG&G's project sponsor to ensure that the objectives of the project, as specified by the terms of the contract, are met to EG&G's satisfaction.

Project Manager - Dean Parson

The project manager is responsible for completing the proposed scope of work according to EG&G/DOE and contract requirements. This includes overseeing project task managers, the quality assurance officer, work quality, and compliance with budget and schedule requirements. Additional specific responsibilities include:

- Technical direction and control of WCFS staff in accordance with contract requirements
- Communications with EG&G concerning management issues, including contract negotiation, contract requirements, and contract modifications (if required)

- Communication with EG&G and WCFS concerning technical issues
- Classification review
- Document control and preparation of administrative deliverables
- Communication with EG&G concerning work progress and findings, cost and schedule issues
- Cost control
- Incorporation of QA activities

The Project Manager is supported by WCFS technical and administrative staff as necessary to perform management duties.

Accounting, Procurement and Contracting

The accounting staff is responsible for preparation of monthly invoices and supporting documentation, as well as accounts payable. The procurement staff is responsible for any procurement of items or equipment for use on the OU-2 project. The contracting personnel handle contracting with subcontractors and with EG&G.

Cost/Schedule Status Reporting

Cost/schedule progress reports will be provided on a monthly basis, as required by EG&G contracting. The cost/schedule reports will briefly summarize progress for the reporting period as well as identify work to be conducted in the next reporting period.

4.2.2 Cost Schedule and Milestone Information

The OU-2 SVE Pilot Testing Program is intended to be a continuous effort until the field work is complete, the tasks are scoped so that costs will be incurred continuously by the personnel assigned to the task. Therefore, costs for the OU-2 SVE field effort will be tracked as a single task. Variance reports will be developed once a month, as specified in the contract documents.

4.3 PROJECT MANAGEMENT CONTROL SYSTEM/PROGRESS MEASUREMENT REPORTING

WCFS employs an Earned Value Project Management system that allows for real time tracking of not only cost and schedule but actual project performance as well. The system is outlined in the following paragraphs.

The Baseline Plan has been prepared for this project and will be provided to EG&G after the cost negotiations are completed. This plan will be the benchmark against which the accumulated costs and the schedule progress will be measured. A working plan will be maintained by WCFS to reflect the latest schedule and budget status of each activity in each task. Updated schedules will be produced throughout the project, as required.

The Budgeted Cost of Work Performed (BCWP) is determined by the Task Managers using the Performance Measurement Plan as guidance in determining a value that represents the work accomplished to date relative to the total Budget at Completion (BAC) for each work element. In this project, managers of each discrete work element will give weekly progress updates to the project manager.

The Budgeted Cost of Work Scheduled (BCWS), which comes directly from the Baseline Plan, is combined with the BCWP and the ACWP on the Cost/Schedule Status Report (C/SSR) form, and then the Schedule Variance (SV) and Cost Variance (CV) are calculated.

The Task Managers input the Latest Revised Estimate (LRE), which is compared to the BAC generated in the Baseline Plan, and the Variance at Completion (VAC) is calculated.

5.0 COST ESTIMATE

A project cost estimate is provided in Table 5-1, as required by the RFP Interagency Agreement (IAG) (DOE 1991) for the implementation of the OU-2 Subsurface IM/IRA Pilot Test .

TABLE 5-1

SVE PILOT TEST COST ESTIMATE

TASKS	COST
Planning and Engineering	$ 870,000
Pilot Test Trailer	$ 480,000
Well Installation	$ 190,000
Trailer Support Equipment and Piping	$ 180,000
Pilot Test Operations	$ 350,000
Sustained Operations	$ 290,000
Report	$ 90,000
TOTAL	$2,460,000

6.0 REFERENCES

EG&G. 1993 EMD Operating Procedures. Volume I. Field Operations.

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EG&G. 1993. Final Pilot Test Plan Soil Vapor Extraction Technology, Subsurface Interim Measures/Interim Remedial Action, East Trenches Area, Operable Unit No. 2. January 12.

EG&G. 1991. Rocky Flats Plant Side-Wide Quality Assurance Project Plan.

EG&G. 1990. General Radiochemistry and Routine Analytical Services Protocol (GRRASP).

EPA. 1984. Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air. EPA/600/4-84-04.

RTG. 1993. Mobile Soil Vapor Extraction Pilot Unit Drawing.

U.S. Department of Energy. 1993. Final Project-Specific Health and Safety Plan for Soil Vapor Extraction Subsurface Interim Measures/Interim Remedial Action East Trenches Area. Rocky Flats Plant, Golden, Colorado. August.

U.S. Department of Energy. 1991. Rocky Flats Interagency Agreement (IAG)

APPENDIX A
MATERIAL AND EQUIPMENT SPECIFICATIONS

SECTION PIPING-1
PIPING INSULATION

1.0 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 REFERENCES

A. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

B. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

E. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

F. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

G. ASTM E84 - Surface Burning Characteristics of Building Materials.

1.3 RELATED SECTIONS

A. Section Piping-2.

1.4 QUALITY ASSURANCE

A. Insulation materials conform to ASTM E84 surface burning characteristics of building materials.

B. Insulation shall be installed per manufacturer's installation instructions.

1.5 QUALIFICATIONS

A. Applicator

Company specializing in performing the Work of this section with a minimum of three years of experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site in an orderly manner.

B. Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

2.0 PRODUCTS

2.1 PIPE INSULATION

A. All aboveground groundwater transfer piping outside enclosures shall be insulated.

B. 3-inch containment pipe shall have 1-1/2-inch thick, preformed fiberglass pipe insulation, CERTAINTEED 500° Snap-On or equal.

C. Insulation shall be covered with a smooth finish aluminum vapor barrier jacket of .016 inch thick sheet.

D. Fitting shall be .016-inch-thick die-shaped fitting covers with factory attached protective liners.

E. Jacket shall be attached with 3/8-inch-wide, .015-inch-thick aluminum bands.

F. Jacket shall be joined with longitudinal slip joints and 2-inch laps.

3.0 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed and dry.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Provide vapor barrier jackets, field applied.

C. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations.

D. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections and expansion joints.

E. Install galvanized insulation shields between aluminum jacket and pipe supports.

F. Insulate fittings, joints and valves with insulation of like material, thickness and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicate.

SECTION PIPING-2
PIPING

1.0 GENERAL

1.1 SECTION INCLUDES

A. Groundwater transfer piping.

B. Air injection piping.

C. Vapor extraction piping.

D. Storage tank vent piping.

1.2 RELATED SECTIONS

A. Section Piping-1 Piping Insulation.

1.3 REFERENCES

A. ANSI B16.11 - Forged Steel Fittings, Socket Welded and Threaded.

B. ANSI B16.21 - Non-metallic Flat Gaskets for Pipe Flanges.

C. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

D. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

E. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

F. ASTM D1784 - Polyvinyl Chloride Plastic Pipe.

G. ASTM D2467 - Socket Type Polyvinyl Chloride Plastic Pipe and Fittings.

H. ASTM 2564 - Solvent Cements for Polyvinyl Chloride Plastic Pipe and Fittings.

I. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

J. ASME Section IX - Welding and Brazing Qualifications.

1.4 SUBMITTALS

A. Contractor shall maintain a log sheet listing all pressure testing of piping systems. Log information shall include date, time, line number, test pressure, test duration, and results of test.

1.5 QUALITY ASSURANCE

A. Welding materials and procedures conform to ASME Section II, Material Specifications, Part C, Welding Rods, Electrodes, and Filler Metals.

B. Welder's Certification

In accordance with ASME Section IX, Welding and Brazing Qualifications.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site in an orderly manner.

B. Accept valves on site in shipping containers with labelling in place. Inspect for damage.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

2.0 PRODUCTS

See data sheets at the end of this section.

3.0 EXECUTION

3.1 GENERAL

A. The Contractor shall furnish all tools, equipment, materials, and supplies, and perform all labor required for furnishing the complete installation, testing, and flushing of all piping and appurtenances as shown on the Drawings and specified herein.

B. All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and wherever possible, be the standard product of the manufacturer. They shall be furnished in pressure or thickness classes as specified or shown.

C. The different kinds of above ground piping shall be installed in accordance with the Drawings, procedures and methods contained within this Specification. Such procedures and methods shall conform to or exceed the minimum requirements of the pipe manufacturer and shall be as supplemented by the provisions specified herein. The interior of the pipe, fittings and couplings shall be clean and free from contamination when installed. Effective means shall be taken to prevent the entrance of foreign matter following installation. Where fittings are omitted from the Drawings, they shall be the same size as the piping and in all cases shall conform to the piping code requirements.

D. All pipe shall be carefully placed and supported at the proper lines and grades, and where practicable, shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustment to avoid architectural and structural features. If relocations are required, they shall be subject to the approval of the Engineer.

E. In the event that obstructions not shown on the Drawings which will require alterations to the Drawings are encountered during the progress of the Work, the Engineer will have the authority to change the Drawings and order the necessary deviations from the line or grade. The Contractor shall not make any deviation from the specified line or grade without approval by the Engineer. Should any deviation in line or grade be permitted by the Engineer for the convenience of the Contractor, any additional costs for thrust blocks, valves, blow-off assemblies, extra pipe footage, or other additional costs shall be borne by the Contractor.

F. Storage and Handling

During storage, handling, and transporting, every precaution shall be taken to prevent injury to pipe. Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings or by other methods approved by the Engineer for the pipe used.

G. Verification of Dimensions

All dimensions essential to the correct locations of the pipe, or fit of piping at equipment and valves, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Contractor prior to fabrication of the piping involved. Any required change from the nominal

locations shown on the Drawings shall be made by the Contractor and shall be included as a part of the Work hereunder and will be subject to the approval of the Engineer.

I. Contractor shall provide non-conducting dielectric connections wherever joining dissimilar metals.

J. All valves shall be installed with stems upright or horizontal, not inverted.

3.2 ABOVE GROUND PIPING INSTALLATION

A. All piping shall be installed in accordance with the erection Drawings. The horizontal piping shall be level except where otherwise shown or specified; parallel lines shall be grouped on the same horizontal or vertical plane wherever possible. Vertical piping shall be plumb and the entire piping configuration shall allow adequate clearances for convenient access for painting and preventive maintenance of valves. Piping shall clear obstruction, preserve headroom and keep openings and passageways clear. If structural difficulties or other Work prevent the running of pipes or the setting of equipment at the point indicated on the Drawings, the necessary minor deviations therefrom, as determined by the Engineer, will be allowed and shall be shown on the erection Drawings to be furnished. Except as otherwise shown or specified, piping installation Work shall conform to the requirements of ASME B31.3 and the printed or written recommendations of the manufacturer of the product involved for the given conditions.

B. Horizontal and vertical pipes shall be anchored securely by means of pipe hangers or supports. Sufficient unions shall be provided to facilitate disassembly of the pipe. Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform to the requirements of ANSI B2.2-1968. In making up threaded joints, teflon tape shall be applied to the male ends only.

C. The Contractor shall provide pipe hangers, brackets, saddles, clamps and other supports as necessary to support all dead loads, live loads and dynamic loads experienced by the piping and appurtenances. Pipe supports conforming to these requirements shall be supplied whether or not shown on the Drawings. Supports shall be provided at, but not limited to, points of change in direction, both sides of flexible joints, dead ends and maximum spacing as defined by this specification. In general, all piping should be supported from the ground or building walls as much as feasible.

D. Where specified or shown, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of steel. Where submerged in process fluids or where located in covered manholes, boxes, etc., bolts, stud bolts, rods, yokes and nuts

of hangers and supports shall be of silicon bronze. Bolts shall not be less than 1/4-inch diameter unless otherwise called for on the Drawings.

E. Design

Hangers and supports shall be adequate to maintain the pipelines, apparatus and equipment in proper position and alignment under all operating conditions. Hangers and supports shall be as shown on drawings or as approved by the Engineer.

3.4 TESTING

A. Leak testing of piping system integrity shall be by either hydrostatic or pneumatic test methods listed below:

1. 3/4-inch, 1-inch HDPE carrier pipe, and 3/4-inch carbon-steel groundwater well pipe hydro at 50 PSIG.
2. 6-inch PVC vapor extraction pipe, pneumatic at 15 PSIG.
3. 4-inch steel air injection pipe - pneumatic at 15 PSIG.
4. 3-inch PVC containment, pneumatic at 15 PSIG.

B. All tests shall be held for 2 hours. Contractor shall identify piping components, i.e., meters, instruments, that may not be designed for full hydrotest pressure and make provisions for testing the piping system with those components removed, as required.

C. Leaks shall be located, repaired, and the line retested to the satisfaction of the Engineer.

D. After the pipeline has been laid, it should be filled with water, taking care to bleed off any trapped air. It should then be subjected to a hydrostatic pressure test, with a test pressure at the lowest elevation to the system, that is a maximum of 1.5 times the system design pressure. When, in the opinion of the Engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, the pressure test may be made after backfilling has been completed but not sooner than that time which will allow sufficient curing of any concrete that may have been used (typical minimum concrete cure times are 36 hours for early strengths and 7 days for normal strength materials).

E. Pressure drops due to the thermal contraction are acceptable, if the pressure returns to the original test pressure after 2 hours.

3.5 SYSTEM FLUSHING

A. After tests are completed, piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration.

B. Contractor shall not flush the containment pipe as it is important to keep the annulus as dry as possible.

	Woodward-Clyde Engineering Specification	Standard Number C
By: DWG Approved : DRP	Piping Material Specification	Page 1 of 2 Issued: 07-15-93 Revised: _____

Recommended Service: Air injection, groundwater well

Maximum allowable pressure and temperature

Temperature, degrees F	100	150	200	250	300	350
Pressure, PSIG	285	272	260	245	230	215

PIPE	DESCRIPTION
1/2 inch through 2 inch	Schedule 40, ASTM A120 Grade A or B, seamless carbon steel, galvanized
2 1/2 inch through 10 inch	Schedule 40 ASTM A53 grade A or B seamless carbon steel
VALVES	
2 inch and smaller	Ball, bronze, screwed, Worcester Figure No. 4211T or approved equal. Check, bronze, screwed, swing, Jenkins Figure No. 762S or approved equal. Gate, bronze, screwed, Jenkins Figure No. 270C or approved equal. Globe, bronze, screwed, Crane Figure No. 70 or approved equal.
2-1/2 inch and larger	Butterfly (lug), Class 150, carbon steel, Jamesbury Figure No. 815L or approved equal. Check, Class 150, carbon steel, flanged swing, Jenkins Figure No. 1025-B2 or approved equal. Globe, Class 150, carbon steel flanged, Jenkins Figure No. 1040-B or approved equal. Plug, Class 150, carbon steel, flanged, lubricated, Powell Figure No. 1559 (1 inch to 4 inches), 1559-G (6 inches to 12 inches).

	Woodward-Clyde Engineering Specification	Standard Number C
By: DWG Approved : DRP	Piping Material Specification	Page 2 of 2 Issued: 07-15-93 Revised: _____

FITTINGS	
1-1/2 inch and smaller	ANSI B16.11 Class 300 forged carbon steel, galvanized ASTM A106, screwed.
2 inch and larger	NASI B16.9 seamless ASTM A234 Grade WPB, butt weld, same sch. as pipe.
FLANGES	
1-1/2 inch and smaller	ANSI B16.5 Class 150 forged carbon steel, galvanized ASTM A105, FF, screwed, same sch. as pipe.
2 inch and larger	ANSI B16.5 Class 165 forged carbon steel, ASTM A105, FF, weld neck.
UNIONS	
1-1/2 inch and smaller	Class 3000 forged carbon steel, galvanized, screwed, ASTM A105, steel/steel seats.
2 inch and larger	Flanges as specified above.
BRANCH CONNS.	
1-1/2 inch and smaller	Screwed tee (use insert for reducing).
2 inch and larger	Full size branch: Tee Branch 2-1/2 inch and larger: Stub-in Branch 2 inch and smaller: Threadolet
BOLTS	
(All sizes)	Alloy bolt studs, ASTM A193 Grade B7 with hex nuts to ASTM A194 Grade 2H, heavy weight.
GASKETS	ANSI B16.5 Class 150 spiral wound gaskets with 304 stainless steel and non-asbestos (Chlorite Mineral) filler and 1/8 inch carbon steel compression gauge rings.

	Woodward-Clyde Engineering Specification	Standard Number P
By: DWG Approved : DRP	Piping Material Specification	Page 1 of 1 Issued: 07-15-93 Revised:

Recommended Service: Groundwater transfer carrier.

TUBE	DESCRIPTION
3/4 inch and 1 inch	SDR 11 coils, high molecular weight, polyethylene pipe meeting ASTM D3035 and F714, Ryan Herco 0526 or approved equal.
FITTINGS	
3/4 inch and 1 inch	Molded, insert type, pressure rating equal to or better than tuber, high density polyethylene Ryan Herco or approved equal.
VALVES	
3/4 inch and 1 inch	Globe, angle, bronze, screwed (Crane Figure No. 384P or approved equal). Check, bronze, screwed (Jenkins Figure No. 762A or approved equal).

	Woodward-Clyde Engineering Specification	Standard Number G
By: DWG Approved : DRP	Piping Material Specification	Page 1 of 2 Issued: 07-15-93 Revised:

Recommended Services: Groundwater transfer, above grade groundwater transfer containment and leak detection, vapor extraction, and tank vents.

PIPE	
1/2 inch thru 2 inches	Schedule 80, PVC, Class 12454-B, threaded or plain ends, in accordance with ASTM-D-1784.
2-1/2 inch thru 8 inches	Schedule 80, PVC, Class 12454-B, threaded or plain ends in accordance with ASTM D-1784.
VALVES	
1/2 inch thru 1-1/2 inch	Ball, Class 150, bronze, screwed, True Union Ball Valve or equal.
6 inches	Butterfly, PVC body, polypropylene seat, EPDM disc, Harrington Part No. BFVPVE-000A or equal.
FITTINGS	
1/2 inch thru 1-1/2 inch	Type 1 , Grade 1, PVC, class 12454-B, Schedule 80, screwed.
2 inches thru 8 inches	Type 1, Grade 1, PVC, Class 12454-B, Schedule 80, socket or screwed.
FLANGES	
2 inches thru 8 inches	Type 1, Grade 1, Class 150, flat face, PVC, Schedule 80, socket or screwed.
UNIONS	
1/2 inch thru 3 inches	Type 1, Grade 1, PVC, Schedule 80, socket or screwed.
BOLTS	
All sizes	Hex head machine bolts, ASTM A307, Grade B with heavy hex nuts.
GASKETS	
All sizes	1/8 inch neoprene, full face, 50-70 durometer A, Class 150.

	Woodward-Clyde Engineering Specification	Standard Number G
By: DWG Approved : DRP	Piping Material Specification	Page 2 of 2 Issued: 07-15-93 Revised:

CEMENT FOR SOCKET

JOINTS	Heavy duty industrial grade, Nibco/Chemtrol PVC solvent cement or approved equal.
PRIMER	Primer as recommended by the manufacturer of the pipe and pipe fittings.

ELECTRICAL SPECIFICATIONS

1.0 GENERAL REQUIREMENTS

A. The installation shall comply, as a minimum requirement, with the applicable rules of the latest edition of the National Electrical Code (NEC).

B. All electrical materials shall be new and as listed by the Underwriters' Laboratories, Inc. (UL), where available, except as otherwise specified herein or approved by the Engineer.

C. The drawings indicate the extent and general arrangement of the conduit and wiring systems.

D. Materials furnished shall be suitable for use in a temperature range of -20°F to 100°F.

2.0 RIGID NON-METALLIC CONDUIT

A. Provide NEMA TC2-Electrical Plastic Conduit (EPC-40) with NEMA TC3-PVC Fittings for use with rigid Sch. 80 PVC conduit.

B. Install nonmetallic conduit in accordance with manufacturers' instructions. Support conduit with coated steel or malleable iron straps.

C. Arrange conduit to present neat appearance.

D. Use conduit hubs or sealing locknuts to fasten conduit to boxes.

3.0 WIRE AND CABLE

A. General - All conductors for power and control shall be sized according to the American wire gage (AWG) standard. All conductors shall be copper.

Conductors sized #12 or #10 may be solid or stranded, all other conductors shall be stranded. Minimum size shall be No. 12. Splices are not permitted.

B. Conductors shall be 600 volt and Type THW, type THWN, or Type XHHW.

C. Instrumentation Cable (#18 AWG, TSP)

Provide UL listed type TC, 300V annealed copper single twisted pair with aluminum coated mylar tape and tinned copper drain wire over the pair and PVC or XLPE insulation overall.

D. The Contractor shall test, under supervision of the Buyer or his/her designated representative, all wiring and connections for continuity and grounds, and he/she shall demonstrate, by Megger test, the insulation resistance of all circuits or groups of circuits. Where such insulation resistance tests indicate the possibility of faulty insulation, the Contractor shall locate the point of fault, replace same with new material, and demonstrate by further test the elimination of such fault.

E. Each conductor shall be identified at each end using Contractor's number system. Wire markers shall use indelible ink or other permanent means of marking and will be securely attached to the conductor.

All wiring shall be color-coded per the requirements of the latest edition of the NEC and as contained in the Standard.

Color-coded wires which are #6 AWG or smaller will be factory colored, those larger than #6 AWG may be black with colored tape banding at each end.

Ungrounded (Hot/Phase) power feeder and branch circuit wiring shall be color coded and labeled at each end and at all intermediate outlet/junction boxes to clearly identify phasing and voltage. Conductor color and labeling shall be as follows:

Source Type	Description	I.D. Label	120/208 V	277/480V 480V & Above
AC 3 Phase	Phase A	A	Black	Brown
	Phase B	B	Red	Orange
	Phase C	C	Blue	Yellow
	Neutral	Neutral	White	Gray
	Ground		Green or Bare*	Green or Bare
			240V 120V	
AC 1 Phase	Line 1	L1	Black	
	Line 2	L2	Red	
	Neutral		White	
	Ground		Green or Bare*	

*Bare ground conductors shall only be used in PVC conduit or with specific engineering approval.

4.0 HEAT TRACING

A. The Contractor shall provide heat tracing cable and all accessories and completely install the entire heat tracing system so that it will provide complete freeze protection for pipelines (including valves, flanges, etc.) as shown on project drawings.

B. Fluid in pipelines is basically water with limited quantity of contaminants.

C. Approximate minimum water temperature desired is 40°F.

D. Minimum expected ambient temperature is minus 30°F.

E. All pipelines which are to be heat traced are made of either CPVC or polypropylene and are insulated as described in the appropriate specification sections of this Contract.

F. The heat tracing system includes heat tracing cable, end seals, cable ties, fittings, supports, hardware, thermostats, and any other required components. All equipment shall be Chemelex Auto-Trace, or equal.

G. Heat tracing cable shall be self-limiting type which automatically limits its own maximum temperature. Below maximum temperature, the heater shall regulate its own heat output. The built-in temperature control shall be accomplished by a semi-conductive heating material whose electrical resistance varies with its temperature.

H. Heat tracing cable shall have two (2) copper bus wires, a self-regulating semi-conductive core, modified polyolefin jacket, and a fluoropolymer outer jacket covering a tinned copper shield. Heat tracing cable shall be Chemelex Auto-Trace Type 8BTV1-CT or equal with an output of 8 Watts per foot at 50°F or an equivalent member of the "BTV1-CT" family with required heat output for the application.

J. Each heat tracing circuit shall operate at 120 V AC and 60 Hz. Control shall be by an in-line ambient sensing thermostat controller, Chemelex Type AMC-1A. The thermostat controller shall become energized at a temperature of 40°F.

5.0 GROUNDING

A. Provide grounding rods 3/4 inch by 10 feet, copper-clad steel as shown on the drawings.

B. Ground all equipment in accordance with Article 250 of the National Electrical Code.

6.0 LEAK DETECTION

A. Provide Raychem TraceTek 320 alarm system for single point leak detection in three locations: the low point in the double-walled pipe, and each tank. The alarm module shall be Type G, catalog number TTG-4.

B. Provide feedthrough assemblies, TraceTek 320 sensing cable (1 foot at each monitoring location), jumper cable, splice kits, hold-down clips and all other accessories required to make a complete installation.

C. The leak detection junction box shall be a weather protected NEMA 12 or better enclosure equipped with a thermostatically controlled space heater to maintain the temperature above 35°F. The enclosure will be large enough to accommodate the alarm module and all cable.

EQUIPMENT - 1
TANKAGE

INDEX

1.0 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 American National Standards Institute, Inc. (ANSI) Standards

B1.20.1 Pipe Threads, General Purpose (Inch) B16.5 Pipe Flanges and Flanged Fittings

1.1.2 American Petroleum Institute (API) Standards

Spec. 12P Fiberglass Reinforced Plastic Tanks API 650 Welded Steel tanks for Oil Storage

1.1.3 Underwriters Laboratories (UL) Standards

UL 142 Steel Aboveground Tanks for Flammable and Combustible Liquids.

1.1.4 Steel Structures Painting Council (SSPC)

SSPC Paint 20 1982 Zinc Rich Primers Type II "Organic".

1.1.5 Military Specifications (MIL)

MIL-P 24441 Rev B Paint, Epoxy-Polyaride

2.0 SUBMITTALS

The following documents shall be submitted to the Engineer for information only.

* Tank Outline Drawing Showing Dimensions and Locations of all Openings and Anchoring Requirements
* Electric Heat Panel/Tracing Sizing Calculations
* Shop Leak Integrity Test Report*\; *FIO*\
* Internal Tank Coating Application Procedure

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

3.0 SCOPE OF SUPPLY

Tank systems shall include tank, electrical heat panels or immersion heater for temperature maintenance and insulation system. If single wall tanks are proposed for TK-101, means for 110 percent containment of primary tank liquid volume shall be included. Also provisions for eliminating rainfall collection in the secondary containment device are to be included.

4.0 QUALIFICATIONS

4.1. MANUFACTURER

Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

5.0 DELIVERY, STORAGE AND HANDLING

- Deliver, store, protect and handle tanks in an orderly manner.
- Prior to shipment, place temporary caps and closures on all tank openings. Maintain in place until installation.

6.0 PRODUCTS

6.1 SERVICE CONDITIONS, TK-101 and TK-102

6.1.1 Secondary containment required

Yes

6.1.2 Service

Storage of contaminated groundwater

6.1.3 Fluid pH

6.5 to 7.5

6.1.4 Installation

Outdoors, min. ambient temp. of -20°F, max. ambient temp. of 100°F.

6.1.4 Capacity

TK-101 and TK-102 - 10,000 gallons nominal

6.1.5 Type

Horizontal

6.1.6 Design Pressure

Hydrostatic head (atmospheric)

6.1.7 Nominal Dimensions

TK-101 and TK-102 - 8'6" diameter x 27'-0" long

6.1.8 Nameplate

Each major component shall have a nameplate to list the manufacturer's name, address, component type or style, model or serial number, and catalog number on a plate secured to the equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

6.2 TANK DESIGN AND MATERIALS OF CONSTRUCTION

6.2.1 Double Wall Carbon Steel (Integral Secondary Containment)

Tank shall be fabricated to meet the requirements of UL 142. This design shall include a manual means for leak detection in the annulus between the primary and secondary walls. All interior wetted surfaces shall be sandblasted and coated with a corrosion protection coating as recommended by the coating manufacturer for the intended service.

6.2.2 Tank Connections

Piping, vent, or instrument connections to the tank shall be either flanged or threaded. Flange faces shall be drilled to match 150 lb. ANSI bolting geometry. Threaded connections shall be standard female pipe threaded coupling. As a minimum, the tank shall have a 3-inch inlet, 2-inch vent, 4-inch drain, 2½-inch annulus leak detection, 2½-inch level control, 16½-inch immersion heater, and manhole openings. All tank inlet drain and level control nozzles shall have internal downpipes that extend within one foot of the tank floor. Downpipes shall be suitably supported from the tank wall.

6.2.3 Tank Anchorage

Tank shall be skid mounted. A minimum of six auger type helical anchors shall be provided for each tank rated for a minimum pullout load of 12 kips.

6.2.4 Tank Heating System

Tank shall be equipped with 120/1/60 electric heating panel(s) or immersion heater. Heating panel(s) or immersion heater shall be manually controlled. Tank fabricator shall size, provide, and install heating panels or immersion heater suitable for freeze protection.

7.0 EXECUTION

7.1 EXAMINATION

- Prior to tank installation, verify that grade surface has been properly prepared.
- Verify that all tank openings are properly located as fabricated.

7.2 INSTALLATION

- Install tanks in accordance with manufacturer's instructions.
- Tanks shall be installed in as level a condition as possible, not to exceed 1/4-inch slope as measured across the entire tank length.

7.3 INTEGRITY TEST

- After installation is complete, tank shall be field leak tested.

  - Double wall tanks shall be filled with water and checked for leakage over an eight-hour period via the annulus leak detection device.

EQUIPMENT - 2
GRANULAR ACTIVATED CARBON SYSTEMS

INDEX

1.0 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 American National Standards Institute, Inc. (ANSI) Standards

B1.20.1-1983 Pipe Threads, General Purpose (inch)

1.2 DESCRIPTION

Two vapor phase granular activated carbon system is detailed in this specification.

1.3 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.0 SUBMITTALS

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

3.0 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

4.0 PRODUCTS

4.1 VAPOR PHASE CARBON ADSORPTION UNITS

4.1.1 Design Conditions

Carbon vessels shall be capable of removing trace amounts of contaminants, including PCE, TCE, and carbon tetrachloride, from air stream at operating temperatures from 40 to 100°F. Two vessel, installed in series shall be supplied and installed outdoors. Vessels shall have a design pressure of 5 PSIG minimum and a pressure drop at 1.5 PSI maximum.

4.1.2 Type

The carbon vessels shall be supplied in 55 gallon type containers with a carbon volume of 6.5 cubic feet. Activated carbon charge shall be manufactured from bituminous coal and have the following properties:

Size (U.S. Sieve)	4x6 or 4x8
Iodine No. (Min)	1000
Hardness No. (Avg)	90
Ash (Max)	8%
Apparent Density (lbs/ft^3)	30
Carbon Tetrachloride Activity (Min)	62%

4.1.3 Materials of Construction

Vessel shall be carbon steel with suitable corrosion protection coating or liner on internal contact surfaces. Vessel external surfaces shall be painted. PVC is an acceptable material for internal piping distribution headers.

4.1.4 Connections

Inlet and outlet connections shall be female pipe thread couplings. Vessel shall also have a threaded drain connection on the bottom.

5.0 EXECUTION

5.1 EXAMINATION

- Prior to installation of carbon vessels, verify that installation surfaces are suitable for setting the vessels, i.e., reasonably level, compacted surface.

- Verify that all vessel openings agree with outline drawings.

5.2 INSTALLATION

- Install vessels in accordance with manufacturer's instructions.

EQUIPMENT - 3
SUBMERSIBLE WELL PUMP SYSTEM

INDEX

1.0 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 Military Specifications (Mil. Spec)

MIL-T-27730A Tape, Anti-seize, Polytetrafluoroethylene, with dispenser.

1.1.2 American National Standards Institute (ANSI) Standards

B1.20.1-1983 Pipe Threads, General Purpose (Inch)
B16.3-1977 Malleable Iron Threaded Fittings Class 150 and 300

1.1.3 American Society for Testing and Materials (ASTM) Publications

A53-87B Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

2.0 GENERAL REQUIREMENTS

2.1 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use at least 2 years prior to bid opening.

2.1.1 Nameplates

Each pump shall have the manufacturer's name or trademark on a corrosion-resistant nameplate securely affixed in a conspicuous place. The manufacturer's name or trademark may be cast integrally with, stamped, or otherwise permanently marked upon the item of equipment. The nameplate shall show the pump capacity in gallons per minute and pump head in feet. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

2.1.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

2.1.3 Equipment Guards [and access]

Belts, pulley, chains, gears, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be enclosed or guarded.

2.1.4 Spare Parts Data

The Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

2.1.5 Operating and Maintenance Instructions

- Operating instructions outlining the step-by-step procedures required for system start-up and operation shall be furnished. The instruction shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.

- Maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs shall be furnished. The instructions shall include simplified diagrams for the system as installed.

2.1.6 Performance Test Reports

Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

2.1.7 Pump Characteristic Curves

Pump characteristic curves showing capacity in gpm, NPSH, head, and pumping horsepower from 0 gpm to 110 percent (100 percent for positive displacement pumps) of design capacity shall be submitted.

2.1.8 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

3.0 Submittals

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

4.0 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

5.0 PRODUCTS

5.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective publications and other requirements specified herein.

5.1.1 Power Cable

Pump power cable shall be flat, heavy duty PVC jacketed cable, No. 12 two conductor wire with ground lead.

5.2 SUBMERSIBLE WELL PUMPS

Submersible well pumps shall be multistage centrifugal-type pumps designed to pump groundwater containing trace amounts of organic contaminants.

5.2.1 Pump Characteristics

Pump numbers SV1 and SI1 located in the trench wells shall have the following operating characteristics:

5.2.1.1 Pump Service

Groundwater with trace levels of organic contaminants including PCE, TCE, and carbon tetrachloride.

5.2.1.2 Design Operating Point

5 gpm flow, 120 feet total dynamic head.

5.2.1.3 Maximum Operating Point

7 gpm flow, 110 feet total dynamic head.

5.2.1.4 Minimum Operating Point

3 gpm flow, 120 feet head.

5.2.1.5 Impeller Type

Enclosed.

5.2.1.6 Discharge

1 inch FPT.

5.2.1.7 Operating Speed

3450 rpm.

5.2.1.8 Depth of Submergence

25 feet.

5.2.1.9 Motor Type

Submersible; 3450 rpm; Electrical Characteristics 130 V a.c., 1 phase, 60 Hz.

5.2.1.10 Pump Control

High- and low-level shut-off.

5.3 PUMP MATERIALS OF CONSTRUCTION

- Primary pump components shall be fabricated of 300 or 400 series stainless steel. Fasteners, internal valve seats and bearings shall be fabricated from manufacturers standard materials.

- Pump shaft shall be of adequate size and strength to transmit the full driver horsepower with a liberal safety factor.

5.4 ELECTRICAL WORK

Electrical motor-driven equipment specified herein shall be installed complete with motors and controls.

6.0 EXECUTION

6.1 EQUIPMENT INSTALLATION

6.1.1 Pump Installation

Pumping equipment and appurtenances shall be installed in the position indicated and in accordance with the manufacturer's written instructions. All appurtenances required for a complete and operating pumping system shall be provided, including such items as piping, conduit, valves, pumps, drivers, well screen, well casing, pitless adapter, power supply, and controls.

6.2 FIELD TESTING AND ADJUSTING EQUIPMENT

6.2.1 Operations Test

Prior to acceptance, an operational test of all pumps, drivers, and control systems shall be performed to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally, or otherwise defective; is in safe and satisfactory operating condition; and conforms with the specified operating characteristics. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels, and power consumption.

6.2.2 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted.

EQUIPMENT - 4
DIESEL GENERATOR

INDEX

1.0 EQUIPMENT

A. The diesel generator will be suitable for continuous operation from no load to full load at an elevation of 6,000 feet, ambient temperature range of -20°F to 100°F and will be subject to rain, ice, and snow. The expected duration of operation for the machine is 24 hours per day for approximately four months. The machine shall be self-contained, portable, and will only be used to supply an isolated electrical load. Provide the following:

1. 125 kW, 480V, 3 phase, 60 HZ, .80 PF diesel generator.
2. All electrical and mechanical protection required to prevent harmful damage to the machine and as required by the National Electrical Code.
3. Diesel fuel tanks, 50 gallons minimum.
4. Weather protected NEMA 3R enclosure for electrical power connections.
5. Sound abatement.
6. One set of all parts required (if any) for routine maintenance.

2.0 SUBMITTAL REQUIREMENTS

A. Provide manufacture's ratings and performance data including but not limited to:

1. Name plate data.
2. Fuel consumption at full load.
3. Dimensions.
4. Summary of mechanical protection.
5. Summary of electrical protection.

6. Noise levels on the "A" scale at 25 feet at full output.
7. Routine maintenance requirements.
8. Operation manuals.
9. Loading and running restrictions, if any.

EQUIPMENT - 5
IMMERSION HEATER

INDEX

1.0 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to int he text by the basic designation only.

1.1.1 American National Standards Institute, Inc., (ANSI) Standards

ANSI C2 (1990) National Electrical Safety Code

1.1.2 National Fire Protection Association (NFPA)

Two deep tank immersion heaters are detailed in this specification.

1.2 DESCRIPTION

NFPA 70 (1990) National Electrical Codes

Two deep tank immersion heaters are detailed in this specification.

1.3 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least two years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.0 SUBMITTALS

Copies of all laboratory and field test reports shall be submitted to EG&G with the construction QA plan.

3.0 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

4.0 PRODUCTS

4.1 DEEP TANK IMMERSION HEATERS

4.1.1 Design Conditions

Immersion heater shall be capable of maintaining 10,000 gallons of water in a horizontal double wall steel tank at or above 32° F.

4.1.2 Type

Immersion heaters shall be a deep tank 12 kW three-phase 48 oz type supplied with circular or straight blades suitable for water service and fitting through a maximum 16 1/2-inch diameter opening and a split riser adaptable to a manhole cover. The riser shall extend to the bottom of a 8-foot 6-inch O.D. horizontal tank with a 4-inch sludge leg to keep heated section off the bottom heaters shall be manually operated.

4.1.3 Materials of Construction

Type 304 stainless-steel

5.0 EXECUTION

5.1 EXAMINATION

- Prior to installation of heaters, verify that tank opening is suitable for installing the heater and heater riser pipe is proper length.

- Verify that all heater connections agree with electrical drawings.

5.2 INSTALLATION

- Install heaters in accordance with manufacturer's instructions.

pm)

Transmitted To Steve Luker File 4045-6
8-25-93

665

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-GT.6 Rev. 2 PAGE 1 OF 1

TITLE	DATE	DCN NUMBER
Monitoring Wells and Piezometer Installation		

EXPIRES: _____ PROCEDURE REVISION REQUIRED X YES __NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	9 of 18	Section 5.3.1.2	Sediment sumps will be installed for all soil vapor extraction (SVE) wells.

Justification (Reason for change - Provide numbers to reference corresponding items above.)

This DCN replaces a prior SVE DCN which stated that sediment sumps would not be installed for the injection and extraction wells. The use of sediment sumps has no effect on the SVE system. Therefore, sediment sumps will be installed for all wells so that the wells can potentially be used for groundwater monitoring in the future.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
	QAPM	X			User		

13. Approval of Responsible Manager	14. Date	15. Is Posting Required	16. If Yes, by what date	17. Date Posted

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DOCUMENT NUMBER 21000-WP-OU02.07 PAGE 1 OF 1

TITLE	DATE	DCN NUMBER
Pilot Test Plan, Soil Vapor Extraction Technology, Operable Unit No. 2 Final		

EXPIRES: _____ PROCEDURE REVISION REQUIRED X YES __NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	4-16	Section 4.8.2	In bedrock, VOC samples for the extraction and pressure monitor wells will be taken every 5 feet instead of every 2 feet.
(2)	4-1	Section 4	Sediment sumps will be installed for all soil vapor extraction wells.

Justification (Reason for change - Provide numbers to reference corresponding items above.)

1. Drilling refusal is being encountered in the bedrock. To date, there have not been any VOC or radiological field readings above background for this project. VOC samples every 5 feet will be adequate to characterize the bedrock.

2. This DCN replaces a prior SVE DCN which stated that sediment sumps would not be installed for the injection and extraction wells. The use of sediment sumps has no effect on the SVE system. Therefore, sediment sumps will be installed for all wells so that the wells can potentially be used for groundwater monitoring in the future.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
	QAPM	X			User		

13. Approval of Responsible Manager	14. Date	15. Is Posting Required?	16. If Yes, by what Date	17. Date Posted

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-FO.10 Rev. 2 PAGE 1 OF 1

TITLE	DATE	DCN NUMBER
Receiving, Labeling & Handling Environmental Materials Containers	8-18-93	93.07 dw

EXPIRES: 8-18-94 PROCEDURE REVISION REQUIRED X YES _NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	14 of 19	7.2.2	This is a revision to procedures outlined in DCN 5-21000-OPS-93.01. Analytical samples will not be collected for the sole purpose of characterizing drums. Analytical samples will be collected for each borehole in accordance with the project-specific work plan, and those samples will be used to characterize drums. The two sites with no analytical samples will be characterized by samples collected from the closest hole, which will be less than 10 feet away. AVP 8/10/93

DOCUMENT CLASSIFICATION REVIEW WAIVER
PER R.B. HOFFMAN, CLASSIFICATION OFFICE
JUNE 11, 1991

Justification (Reason for change - Provide numbers to reference corresponding items above.)

To clarify the procedures for sampling. Analytical samples will be collected for each borehole, and the results of those analyses will be used to characterize all of the drums from that borehole. Most of the sites for this project are within ten feet of each other. Therefore, the two sites with no analytical samples will be able to adequately characterized by the closest site.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
[signature]	FOR K.B. QA PM	X	8-9-93	[signature]	User	X	08-09-93
				[signature]	User	X	08-10-93

13. Approval of Responsible Manager	14. Date	15. Is Posting Required	16. If Yes, by what date	17. Date Posted
[signature]	8/16/93			

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-GT.1, Rev. 2

Title Logging Alluvial and Bedrock Materials	Date ~~7/13/93~~ SLRD 8·20·93 SLRD	DCN Number 93.06 SLRD

Expires ~~10/13/93~~ SLRD 8·20·94 SLRD Procedure Revision Required X YES ☐ NO

Scope Limitation: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for Additional Space)
1	8	5.1.2.1, para.#6	Add sentence at bottom of paragraph: "This detailed sieving and grain size analysis will not be required for the boreholes drilled as part of the OU2 Soil Vapor Extraction Pilot Study. The geologist's field log will be sufficient for subsurface interpretation purposes."
2	31	Sec. 6.2.4	Add at end of paragraph: Core photography requirements will be lifted for those cores generated by the OU2 SVE Pilot Study.

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JUNE 11, 1991

Justification (Reason for change - Provide numbers to reference corresponding items above.)
1) and 2): The large number of borings and wells installed during the OU2 Phase II RI/RFI in close proximity to the proposed vent wells in the SVE study area makes this degree of detail in logging and core photography redundant and unlikely to improve upon existing data generated from the area.

Concurrence	Organization	Req	Date	Concurrence	Organization	Req	Date
[signature]	FOR QAPM K.B.	X	8.9.93	[signature]	User	✓	8-9-93
[signature]	EOM			A.L. [signature]	User	✓	8-10-93

Approval of Responsible Manager	Date	Is Posting Required?	If Yes, by what date?	Date Posted
[signature]	8/16/93	☐ Yes ☐ No		

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-GT.2 Rev. 2

TITLE	DATE	DCN NUMBER
Drilling And Sampling Using Hollow-Stem Auger Techniques	8·20·93 SLRD	93.04 SLRD

EXPIRES: 8·20·94 SLRD

PROCEDURE REVISION REQUIRED X YES _NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	11 of 14	Section 5.3.3	Three VOC samples will be taken per borehole. VOC sampling will be conducted in accordance with the project-specific work plan. Additional VOC samples will not be taken for elevated OVA readings.

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PER R.B. HOFFMAN, CLASSIFICATION OFFIC.
JUNE 11, 1991

Justification (Reason for change - Provide numbers to reference corresponding items above.)

To clarify that the work plan will override the SOPs on sampling issues for this project.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
[signature]	QAPM K.S	X	8.9.93	[signature]	User	X	08-09-93
				A.L. [signature]	User	X	08-10-93

13. Approval of Responsible Manager	14. Date	15. Is Posting Required	16. If Yes, by what date	17. Date Posted
[signature]	8/16/93			

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-GT.3 Rev. 2 PAGE 1 OF 1

TITLE	DATE	DCN NUMBER
Isolating Bedrock From The Alluvium With Grouted Surface Casing	8·20·93	93.04 seas

EXPIRES: 8·20·94 PROCEDURE REVISION REQUIRED X YES _NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	5 of 10	Section 5.1.1	Centralizers will not be used when installing surface casing.

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Justification (Reason for change - Provide numbers to reference corresponding items above.)

Isolation casing will be installed inside hollow-stem augers. This will ensure that the casing remains straight during installation, and therefore, centralizers will not be needed.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
[signature]	QAPM	X	8·9·93	[signature]	User	X	08-09-93
				[signature]	User	X	8-10-93

13. Approval of Responsible Manager	14. Date	15. Is Posting Required	16. If Yes, by what date	17. Date Posted
[signature]	8/16/93			

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DOCUMENT NUMBER Procedure No. 5-21000-OPS-GT.6 Rev. 2 PAGE 1 OF 1

TITLE	DATE	DCN NUMBER
Monitoring Wells and Piezometer Installation	8·20·93 SEED	93.10 SEED

EXPIRES: ~~December 31, 1993~~ SUD 8·20·94 SEED PROCEDURE REVISION REQUIRED X YES _NO

SCOPE LIMITATION: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for additional space)
(1)	9 of 18	Section 5.3.1.4	If conditions warrant.the bentonite seal may consist of a layer of commercially available bentonite chips instead of bentonite pellets.
(2)	12 of 18	Section 5.3.2.1	If conditions warrant.the bentonite seal may consist of a layer of commercially available bentonite chips instead of bentonite pellets.

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Justification (Reason for change - Provide numbers to reference corresponding items above.)

Bentonite chips are easier to install in some situations, especially when installing monitoring wells in boreholes with water present.

Concurrence	Organization	Req.	Date	Concurrence	Organization	Req.	Date
[illegible]	QAPM [illegible]	X	8.9.93	[illegible]	User	x	08-09-93
				[illegible]	User	x	8-10-93

13. Approval of Responsible Manager	14. Date	15. Is Posting Required	16. If Yes, by what date	17. Date Posted
[signature]	8/16/93			

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Procedure No. Procedure No. 5-21000-OPS-GT.6, Rev. 2

Title Monitoring Wells and Piezometer Installation	Date ~~7/13/93~~ SERD 8.20.93 SERD	DCN Number 93.11 SERD

Expires ~~10/13/93~~ SERD 8.20.94 SERD Procedure Revision Required X YES ☐ NO

Scope Limitation: OU2 Soil Vapor Extraction Pilot Study

Item Number	Page	Step or Paragraph	Changes (Use DCN CONTINUATION SHEET for Additional Space)
1	8	5.3.1.2	4th Sentence: Change to:"A 2-foot sediment sump will not be installed for the SVE extraction and injection wells to allow conformance with design specifications listed in the OU2 SVE Pilot Study Work Plan."
2	12	5.3.2.1	5th Paragraph, 7th sentence: Change to "Installation of protective steel casing will not be required on any well installed for the OU2 SVE Pilot Study to facilitate construction of the vapor collection system."
3	13	5.3.2.2	3rd sentence: Change to "Surface casing will extend from the ground surface to at least 2 feet into bedrock."
4	13-14	5.3.2.3	Well Features at Surface: Change to: "Well features typically included in the surface completion of wells will be deleted for the OU2 SVE Pilot Study to facilitate construction of the vapor collection system."

Justification (Reason for change - Provide numbers to reference corresponding items above.)
1) OU2 SVE Work Plan specifications do not include a sediment sump.
2) and 4) Typical well completion protocols will interfere with the installation of the SVE system.
3) Change required to comply with OU2 SVE Work Plan specifications.

Concurrence	Organization	Req	Date	Concurrence	Organization	Req	Date
[signature]	FOR QAPM, E. B.	X	7.9.93	[signature] D.K.	User	X	8-09-93
[signature]	EOM			A.L. [signature]	USER	X	8-10-93

Approval of Responsible Manager	Date	Is Posting Required?	If Yes, by what date?	Date Posted
[signature]	8/16/93	☐ Yes ☐ No		

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JUNE 11, 1991

AUG 17 1993

APPENDIX C
SYSTEM OPERATION CHECKLIST

SYSTEM OPERATIONS TEST PLAN
SOIL VAPOR EXTRACTION PILOT TEST

1.0 INTRODUCTION

1.1 TESTING AND IMPLEMENTATION OBJECTIVE

Complete testing and inspection of the mobile SVE pilot unit provided as Government Furnished Equipment (GFE) and the field installation to ensure equipment is:

- Installed properly
- Functions as intended
- Confirms previous capacity testing

1.2 DESCRIPTION

Testing and inspection will include:

- Electrical system testing
- Hydrotesting and pneumatic testing of outside piping (External to GFE Trailer)
- Functional testing of instrumentation and control systems
- Functional testing of trailer ancillary systems
- Inspection of facilities and equipment

1.3 REFERENCE MATERIALS

A. The following are reference materials:

- SP 301 - Standard for RFP pipe system testing procedure
- RTG Testing Procedure Rocky Flats Mobile Soil Vapor Extraction Pilot Unit
- RTG Design Drawings
- Engineering Specifications and Drawing, Operable Unit 2 Subsurface IM/IRA Pilot Test Implementation, July 1993

1.4 SPECIAL EQUIPMENT AND MATERIALS

The following special equipment will be required to complete the testing and inspection of the system:

- Electrical testing equipment
- Calibrated pressure gauge
- Calibrated megohmeter with calibration documentation
- Portable air compressor
- Testing documentation from factory acceptance tests performed on GFE

2.0 TESTING AND INSPECTION

2.1 INSPECTION

The Installation Drawings and RTG installation drawings will be used to trace and inspect the following to confirm to systems match the specifications:

- Piping outside trailer
- Piping inside trailer (supplied as GFE)
- Electrical conduit and control cable outside trailer
- Diesel generator, fuel storage tank, and secondary containment
- Tie-down anchors
- Pipe supports
- Stairways
- Forklift access for equipment removal

2.2 ELECTRICAL AND CONTROL SYSTEMS TESTING

This section describes all testing required for electrical power supplied equipment and functional/operational confirmation and control system of the equipment supplied by RTG. Detailed testing of the trailer-mounted equipment supplied by RTG will be performed prior to site delivery.

The following startup and commissioning testing will be performed:

- Diesel generator operation
- Power system connection and operation
- Well pump operation, including well level switches
- Tank immersion heater operation
- Tank level transmitter operation
- Water pipe heat tracing operation
- Tank and water pipe leak detection system operation
- Trailer systems operational tests

2.2.1 Initial Inspection

The following visual inspections shall be made prior to energizing any electrical circuits or operation of any equipment:

1. Confirm all circuits installed by the Electrical Sub-Contractor have been meggered with acceptable results in accordance with RFP electrical standards.

2. Confirm all equipment grounding is completed per specifications, including generator, tanks, electrical boxes, panels, and all trailer equipment.

3. Confirm generator breaker is open, the 480 V disconnect is open, tank heater disconnects are open, and all breakers panel mounted in the trailer are open.

4. Perform a general inspection of all electrical panels and equipment installed in the trailer to ensure no damage occurred during transport. Confirm general working areas and panels are clean and free of debris.

2.2.2 Diesel Generator Startup

1. Review supplier's operation and startup manual.

2. Visually inspect the machine for any damage during transport.

3. Confirm all fluid levels are acceptable, fuel is available, and mechanical protection is intact per the supplier's instruction manual.

4. Start the machine in accordance with the supplier's instructions.

2.2.3 Electrical Power System Startup

1. Close the diesel generator breaker energizing the circuit to the 480 V disconnect. Record and correct any anomalies.

2. Close the 480 V disconnect energizing the circuit to the trailer power panel. Record and correct any anomalies.

3. Close the power panel incoming breaker energizing the panel. Record and correct any anomalies.

4. Close the Blower B-300 circuit breaker, bump the motor and check for rotation.

If rotation is not correct: open all breakers and disconnects, stop the diesel generator, reverse phase connections, restart the diesel generator at the generator breaker, and repeat steps 1 through 4 above.

2.2.4 Well Pump Startup (typical of two)

1. Visually inspect for correct installation, confirming correct level for the pump with a water level indicator and each level switch.

2. Manually change the contact state for each level switch and confirm contact closure is received at the PLC. Correct any anomalies.

3. Ensure the pump is submerged, manually energize the motor and confirm the pump is pumping correctly. Complete the attached single phase motor startup data sheet.

2.2.5 Tank Immersion Heater Startup (typical of two)

1. Visually inspect for correct installation.

2. Confirm immersion heater feeder breakers (located in the trailer) are in the open position.

3. Measure and record megger readings of the heater leads, each phase to ground; and resistance readings, each phase to phase, at the heater disconnects.

ENSURE HEATERS ARE SUBMERGED PRIOR TO ENERGIZING!

4. Close the heater feeder breakers. Measure and record voltage at the disconnects. Close the disconnect and record current in each phase. Complete the attached Immersion Heater Startup Data Sheet.

5. Open the heater feeder breakers in the trailer.

2.2.6 Tank Level Transmitter Startup (typical of two)

1. Visually inspect for correct installation.

2. Calibrate the transmitter by setting zero and span in accordance with the manufacturer's instructions. Confirm the signal is being correctly received and scaled by the PLC.

2.2.7 Water Pipe Heat Tracing Startup

1. Visually inspect for correct installation.

2. Ensure the head tracing feeder breaker is open. Measure and record the resistance of the heat tracing at the power connection terminal box.

3. Close the heat tracing feeder breaker. Slowly increase the thermostat setpoint until the heat tracing cable is energized. Record the setpoint (this should be close to ambient). Measure and record voltage and current.

4. Lower the thermostat setpoint to 40 degrees F confirm the heat tracing cable is de-energized (thermostat contacts open, current is zero).

2.2.8 External Leak Detection Startup

1. Visually inspect for correct installation in accordance with the manufacturer's instructions.

2. Confirm 120 V power is available to the alarm module and the terminal box space heater.

3. Place each detector cable end in water and confirm correct operation of the alarm module. Dry detector cables and replace in ports. Confirm they are located to detect moisture.

2.2.9 Trailer Systems Operational Tests

1. Close the remainder of the trailer panel mounted circuit breakers (excluding the tank immersion heater feeder breakers) one at a time energizing all remainder power and control circuits. Record and correct any anomalies.

2. Manually start each 3-phase motor and complete an attached Three-phase Motor Startup Data Sheet for each motor.

3. Simulate each PLC digital input at the source by shorting the normally open contacts and opening the normally closed contacts. Confirm the PLC receives the correct signal. Record and correct any anomalies.

4. Verify the correct receiving and scaling of each PLC analog input.

5. Verify the correct operation of all automatic functions using the PLC ladder logic as the test basis.

6. Verify the correct operation of the data logger function.

2.2.10 Documentation

Complete the Startup Test Report using the following format and compile all referenced data sheets (attachment C-1) attaching them to the report for future reference.

Initial Inspection Comments and Findings: (*2.2.1)

Diesel Generator Startup Comments and Findings: (*2.2.2)

Electrical Power System Startup Comments and Findings: (*2.2.3)

Well Pump Startup Comments and Findings: (*2.2.4)

Tank Immersion Heater Startup Comments and Findings: (*2.2.5)

Tank Level Transmitter Startup Comments and Findings: (*2.2.6)

Water Pipe Heat Tracing Startup Comments and Findings: (*2.2.7)

External Leak Detection Startup Comments and Findings: (*2.2.8)

Trailer Systems Operational Tests Comments and Findings: (*2.2.9)

***Attachments: Data Sheets**

2.3 HYDROTESTING AND PNEUMATIC TESTING

The inner carrier pipe will be hydrostatically tested prior to the installation of the secondary containment piping. The 3/4-inch, 1-inch HDPE pipe and 3/4-inch carbon steel will be hydrostatically tested at 50 psig (±10%) for a minimum of 2 hours. The piping will be isolated at the well head and the storage tank.

The storage tanks will be hydrostatically tested to confirm there are no leaks. The tanks will be isolated from piping and open to atmosphere. Leak detection systems in the secondary containment shall be operationally tested to detect leaks. The tanks will be filled with water and monitored for 4 hours by checking leak detection monitor for tank, measuring with a dip stick once an hour, and inspecting the outside tank for leaks.

The vapor extraction, secondary containment, and air injection piping will be pneumatically tested for leaks. The piping will be isolated at the well heads, storage tanks, and trailer. Piping will be pressurized with a compressor a to pressure of 15 psig (±10%). All fittings, valve packing gaskets, seams will be soap tested. All detected leaks will be repaired and piping retested.

2.4 SYSTEM TESTING

2.4.1 Extraction System

1. Verify all vapor extraction valves inside the trailer are open.

2. Close vapor extraction piping valves outside from AV1 and SV1 extraction wells.

3. Open make-up air valve to knockout pot.

4. Start Blowers B-300 and B-500 by placing Hand Operated Automatic (HOA) in auto positions. Record airflow meter.

5. Record pressure reading on AV1 and SV1 well heads to confirm shutoff valves are not leaking.

6. Record all system temperature, pressures, and flow rates. Verify system is producing 600 acfm.

7. Isolate Filters FL-200 and FL-210 by closing inlet and outlet valves and record flowrate. Verify minimum 600 acfm flowrate.

8. Isolate Filters FL-210 and FL-220 by closing inlet and outlet valves and record flowrate. Verify minimum 600 acfm flowrate.

9. Isolate Filters FL-200 and FL-220 by closing inlet and outlet valves and record flowrate. Verify minimum 600 acfm flowrate.

2.4.2 Air Injection System

1. Disconnect air injection piping at well head.

2. Start Blower B-600 placing Hand Operated Automatic (HOA) switch in auto position.

3. Record airflow meter.

4. Reconnect piping.

2.4.3 Groundwater Extraction Pumps

1. Open valves from SV1 and SI1 to one storage tank. Isolate other tank from groundwater pumping.

2. Verify tank has been emptied from hydro test.

3. Provide access with capacitor probe to monitor static groundwater table. Record initial water table elevation.

DO NOT TURN ON VAPOR EXTRACTION SYSTEM.

5. Start groundwater pump in SV1 by placing HOA in automatic.

6. Monitor liquid level in pumping well with capacitance probe and automatic gauging unit.

7. Record water table elevation when pump shuts off due to low liquid level.

8. Record water table elevation when pump restarts.

9. Adjust valving to increase or decrease water extraction rate as required.

10. If after 20 minutes of pumping the low-level shutdown has not been achieved, shut down pump. Low-level shutdown will be monitored during pilot test.

11. Repeat test for SI1 injection well.

3.0 DOCUMENTATION

Inspection check sheets and data recording forms will be prepared for this testing plan to record and sign off on testing procedures and to testing results. Draft system check sheet is provided in Table C-1 and C-2. This table will be updated based on Operation and Maintenance (O&M) Manual for pilot and test equipment.

Attachment C-1
Electrical Data Sheet

DIESEL GENERATOR STARTUP DATA SHEET

Project - OU2 Soil Vapor Extraction Pilot Plant

Description - Diesel Generator

Renter/Phone No._____

Nameplate data:

Manufacturer _____ Model No. _____

Serial No. _____ HP/KW _____

Speed _____ Frequency _____

Rated Voltage _____ Full load amps _____

Insulation _____ Enclosure _____

Test Data:

Running Voltage no-load (volts):

A - B _____

A - C _____

B - C _____

Comments:

_____

_____

_____

_____

_____

_____

Recorded by: Witnessed by:

_____ _____

WCFS Date EG&G Date

Attachment C-1
Electrical Data Sheet

SINGLE-PHASE MOTOR STARTUP DATA SHEET

Project - OU2 Soil Vapor Extraction Pilot Plant

Description _____

Motor/Pump or Blower ID _____

Nameplate data:

Manufacturer _____ Model No. _____

Serial No. _____ HP/KW _____

Speed _____ Frequency _____

Rated Voltage _____ Full load amps _____

Insulation _____ Enclosure _____

NEMA code letter_____

Test Data:

Running Voltage no-load (volts): Running Current (amps):

A - B _____ A_____

Starting Current_____

Full load speed_____

Comments:

_____

_____

_____

_____

Recorded by: Witnessed by:

_____ _____

WCFS Date EG&G Date

Attachment C-1
Electrical Data Sheet

IMMERSION HEATER STARTUP DATA SHEET

Project - OU2 Soil Vapor Extraction Pilot Plant

Description - Tank Immersion Heater

Heater / Tank ID: _____

Nameplate data:

Manufacturer _____ Model No. _____

Serial No. _____ Rated kW _____

Frequency _____ Rated Voltage _____

Full load amps _____ Insulation _____

Test Data:

Megger (Mohms): Resistance (ohms):

A - GND_____ A - B_____

Starting Current_____

Full load speed_____

Comments:

_____

_____

_____

_____

_____

_____

Recorded by: Witnessed by:

_____ _____

WCFS Date EG&G Date

Attachment C-1
Electrical Data Sheet

THREE-PHASE MOTOR STARTUP DATA SHEET

Project - OU2 Soil Vapor Extraction Pilot Plant

Description - _____

Motor/Pump or Blower ID: _____

Nameplate data:

Manufacturer _____ Model No. _____

Serial No. _____ Horsepower _____

Speed _____ Frequency _____

Rated Voltage _____ Full load amps _____

Insulation _____ Enclosure _____

Test Data:

Running Voltage (volts): Running Current (amps):

A - B _____ A _____

A - C _____ B _____

A - C _____ C _____

Starting Current (Phase A) _____

Full load speed _____

Comments:

_____

_____

_____

Recorded by: Witnessed by:

_____ _____

WCFS Date EG&G Date

APPENDIX C
TABLES

TABLE C-1

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
Piping		- Exterior vapor extraction piping		
		• Check for cracks		
		• Confirm pressure testing for the lines is complete and documentation is available		
		• PVC UV protected		
		• Piping supported and sloped properly		
		• Installation matches installation drawings and specifications		
		- Groundwater extraction piping		
		• Check for cracks		
		• Pressure testing of the piping complete and documentation available		
		• Leak detection install at low point		
		• Piping is supported and sloped properly		

TABLE C-1
(Continued)

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
		• Electric tracing and insulation installed properly, working properly		
		• Piping system matches installation design drawings		
		• System lines can be blown clear with compression air or drained when unit is not in use.		
		- Interior Piping Groundwater/Soil Gas		
		• Piping matches design drawings		
		• Inspect for cracks and loose connections		
		• Confirm pressure testing for piping and equipment is complete and documentation is available		
		• Verify piping is adequately supported		
Valves		- Match installation drawings and specifications		

TABLE C-1
(Continued)

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
		- Operate properly (i.e., on/off)		
Blowers		- Inspect/test in accordance with (IAW) manufacturer's procedures		
		- Check for excessive vibration, noise during operation. Blower supported and secured properly		
		- Match design drawings and specifications		
Knockout Drum		- Inspect IAW manufacturer's procedures		
		- Tank installed with demister. Documentation verifying installation		
		- Liquid level switches/alarms installed and tested. Documentation available.		
		- Secondary containment installed and tested. Documentation available.		
GAC Units		- Inspect/test IAW manufacturer's procedures		

TABLE C-1
(Continued)

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
		- Units are supported and secured properly		
		- Units installed following design drawings and specifications		
		- Units contain GAC that matches specification and in good condition. Documentation available.		
HEPA Filters		- Inspect for debris/blockage		
		- Inspect/test IAW manufacturer's procedures		
		- Units are supported and secured properly		
		- Units match design drawing and specifications		
Alarms/Automatic Shutdowm		- Inspect/test for proper operation at design settings IAW manufacturer's procedures. Documentation available.		
		- Verify alarms/automatic shutoffs are in their proper place IAW design drawings and specifications		

TABLE C-1
(Continued)

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
		- Verify that alarms are connected into main control board		
Monitoring Equipment/ Instrumentation		- Inspect/test/calibrate IAW manufacturer's procedures. Documentation on all calibrations and testing is available.		
		- Inspect equipment for damage. Verify proper operation.		
Diesel Generator		- Inspect/test IAW manufacturer's procedures		
		- Inspect generator for fuel leaks		
		- Verify generator is operational		
		- Inspect 500 gallon diesel tank for leaks or cracks		
		- Inspect transfer pump for proper operation		
Groundwater Pumps		- Inspect/test IAW manufacturer's procedures		
		- Verify pumps are operating properly		

TABLE C-1
(Concluded)

SYSTEM OPERATION (SO) EQUIPMENT TESTING CHECK LIST

Equipment	Date	Test/Inspection	Contractor	Buyer
Sampling Cabinet		- Verify proper operation, valves open and close properly without leaks		
		- Inspect copper lines for cracks and leaks		
		- Inspect exhaust fan for proper operation		
Field Instruments		- Verify proper operation/calibration IAW manufacturer's procedures. Documentation available.		

TABLE C-2

SYSTEM OPERATION (SO) SYSTEM TESTING CHECK LIST

System	Date	Test/Inspection	Contractor	Buyer
Extraction System		- Verify all vapor extraction valves inside the trailer are open.		
		- Close vapor extraction piping valves outside from AV1 and SV1 extraction wells.		
		- Open make-up air valve to knockout pot.		
		- Start Blowers B-300 and B-500 by placing Hand Operated Automatic (HOA) in auto positions. Record Airflow meter.		
		- Record pressure reading on AV1 and SV1 well heads to confirm shutoff valves are not leaking.		
		- Record all system temperature, pressures, and flow rates. Verify system is producing a minimum of 600 acfm.		

TABLE C-2
(Continued)

SYSTEM OPERATION (SO) SYSTEM TESTING CHECK LIST

System	Date	Test/Inspection	Contractor	Buyer
		- Isolate Filters FL-200 and FL-210 and record flowrate. Verify system is producing a minimum of 600 acfm.		
Air Injection System		- Isolate Filters FL-210 and FL-220 and record flowrate. Verify minimum 600 acfm flowrate.		
		- Isolate Filters FL-200 and FL-220 and record flowrate. Verify minimum 600 acfm flowrate.		
		- Disconnect air injection piping at well head. Verify minimum 600 acfm flowrate.		
		- Start Blower B-600 placing Hand Operated Automatic (HOA) switch in auto position.		
		- Record airflow meter.		
		- Reconnect piping.		
Groundwater Extraction Pumps		- Open valves from SV1 and SI1 to one storage tank. Isolate other tank from groundwater pumping.		

TABLE C-2
(Continued)

SYSTEM OPERATION (SO) SYSTEM TESTING CHECK LIST

System	Date	Test/Inspection	Contractor	Buyer
		- Verify tank has been emptied from hydro test.		
		- Provide access with capacitor probe to monitor static groundwater table. Record initial water table elevation.		
		- Start groundwater pump in SV1 by placing HOA in automatic.		
		- Monitor liquid level in pumping well with capacitance probe and automatic gauging unit.		
		- Record water table elevation when pump restarts.		
		- Adjust valving to increase or decrease water extraction rate is required.		
		- Wait 20 minutes. If the low-level shutdown has not been achieved, shut down pump. Check low-level shutdown operation during pilot test.		
		- Repeat test for SI1 injection well.		

APPENDIX D
PILOT TEST TABLES

PILOT TEST NO. 1 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- Minimum Duration - 4 hours
- Total number of soil gas sample - 6 (includes 4 soil gas samples, 1 makeup air sample, 1 duplicate)
- Sample Analysis Turnaround Time - 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 2-1 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
APM1	X						
APM2	X						
APM3	X						
AI1	X						
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- SVI vent pressure - 60 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround - 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 2-2 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
APM1	X						
APM2	X						
APM3	X						
AI1	X						
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- SVI vent pressure - 100 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 2-3 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
APM1	X						
APM2	X						
APM3	X						
AI1	X						
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- SVI vent pressure - 140 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 3-1 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	**Q**	**T**	**RH**	**GW**	**Rad**	**OVA**	**HC**
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 100 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 3-2 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 140 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 3-3 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	**Q**	**T**	**RH**	**GW**	**Rad**	**OVA**	**HC**
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 180 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 4-1 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 100 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 4-2 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 140 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 4-3 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	**Q**	**T**	**RH**	**GW**	**Rad**	**OVA**	**HC**
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - 180 in H_2O
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 48 hours
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 5 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
AV1	X	X					X	X
APM1	X							
APM2	X							
APM3	X							
AI1	X							
SV1	X	X					X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- Minimum duration - 16 hours
- Total number of gas samples in SUMMA canisters - 23 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 14 days
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 6 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
APM1	X						
APM2	X						
APM3	X						
AI1	X						
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- AVI vent pressure - optimum from Pilot Test No. 2
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 14 days
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 7 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - optimum from Pilot Tests 3 and 4
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 14 days
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 8 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency						
	P	Q	T	RH	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location							
AV1	X	X				X	X
APM1	X						
APM2	X						
APM3	X						
AI1	X						
Dilution Air Line	X	X	X	X			
Vapor Manifold	X		X	X			
B-300 Out	X		X	X		X	X
GAC-1 Out (D-400)	X					X	X
GAC-2 Out (D-410)	X					X	X
Stack	X	X	X		X	X	

- AVI vent pressure - optimum from Pilot Test No. 2
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 14 days
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

PILOT TEST NO. 9 - SCHEDULE OF MEASUREMENTS

	Measurement/Frequency							
	P	Q	T	RH	GW	Rad	OVA	HC
	1/(4-hour)	1/(4-hour)	1/(hour)	1/(4-hour)	1/(4-hour)	1/(2-hour)	1/(4-hour)	1/(4-hour)
Location								
SV1	X	X			X		X	X
SPM1	X							
SPM2	X							
SI1	X				X			
Dilution Air Line	X	X	X	X				
Vapor Manifold	X		X	X				
B-300 Out	X		X	X			X	X
GAC-1 Out (D-400)	X						X	X
GAC-2 Out (D-410)	X						X	X
Stack	X	X	X			X	X	

- SVI vent pressure - optimum from Pilot Tests 3 and 4
- Minimum Duration - 16 hours
- Total number of gas samples in SUMMA canisters - 19 (includes 16 soil gas samples, 1 makeup air sample, and 2 duplicate samples)
- Sample analysis turnaround time- 14 days
- GAC 2 Out samples require EPA CLP analysis and validation. All other soil gas samples require Certificate of Analysis.

Summary of Soil Gas Sampling

	Sampling Requirements				Analytical Requirements		
Pilot Test Number	**Soil Gas Samples**	**Make-up Air Samples**	**QA Samples**	**Total Number of Samples Collected**	**Number of CLP Samples[1]**	**Number of Certificate of Analysis Samples[2]**	**Analysis Turnaround Period**
1	4	1	1	6	1	5	48 hrs
2-1	16	1	2	19	5	14	48 hrs
2-2	16	1	2	19	5	14	48 hrs
2-3	16	1	2	19	5	14	48 hrs
3-1	16	1	2	19	5	14	48 hrs
3-2	16	1	2	19	5	14	48 hrs
3-3	16	1	2	19	5	14	48 hrs
4-1	16	1	2	19	5	14	48 hrs
4-2	16	1	2	19	5	14	48 hrs
4-3	16	1	2	19	5	14	48 hrs
5	20	1	2	23	5	18	14 days
6	16	1	2	19	5	14	14 days
7	16	1	2	19	5	14	14 days
8	16	1	2	19	5	14	14 days
9	16	1	2	19	5	14	14 days
Total	232	15	29	276	71	205	

[1] Samples collected from the stack including one duplicate per run

[2] Samples collect from the wellhead(s), Blower B-300 outlet, and the GAC D-400 outlet including one duplicate per run

APPENDIX E
GEOTECHNICAL ENGINEERING CONSIDERATIONS, TRAILER AND TANK TIE-DOWN ANCHORS

GEOTECHNICAL ENGINEERING CONSIDERATIONS, TRAILER AND TANK TIE-DOWN ANCHORS

A geotechnical engineering evaluation was conducted for the helical anchors that will be used for the trailer and tank tie-downs for the subject project. The information presented in this report is based on our knowledge of the subsurface conditions in the immediate vicinity of the site through previous drilling on Operable Unit No. 2, and empirical information provided by D&B Drilling Inc., regarding the performance of numerous similar anchors that they have installed at Rocky Flats.

Proposed Installation

The project requires that a 8 1/2-foot-wide by 48-foot-long trailer and two 10,000-gallon tanks be set up at the locations shown in Figure 1. Tie-downs are required to prevent movement or damage during high winds. The tie-downs will be anchored with helical, screw-type anchors to avoid the excavation of soils typically required for other types of anchors. The anchors that will be installed are manufactured by the A.B. Chance Company and will be installed by D&B Drilling, Inc., an approved Chance anchor installer. D&B Drilling has previously installed numerous screw anchors at Rocky Flats.

The project drawings indicate that four anchors are required for the trailer. The four anchors for the trailer require a design capacity of 12 kips each. Calculations conducted by Woodward-Clyde indicate that anchors with a 12-kip capacity will also be sufficient for the tank tie downs. Four anchors will be used for each tank. The project specifications require that the anchors be proof-tested to 150 percent of the design capacity, or 18 kips, after they are installed. For the required capacity, D&B Drilling proposes to use anchors with a 1 3/4-inch shaft, 8-inch helixes, and a length of at least 5 feet (Chance Catalog No. C150-0010).

Subsurface Conditions

Woodward-Clyde has conducted extensive subsurface investigation in the Operable Unit No. 2 area. This includes several boreholes and wells in the immediate vicinity of the site, four of which are shown in Figure 1. Logs of these boreholes and wells are attached. The

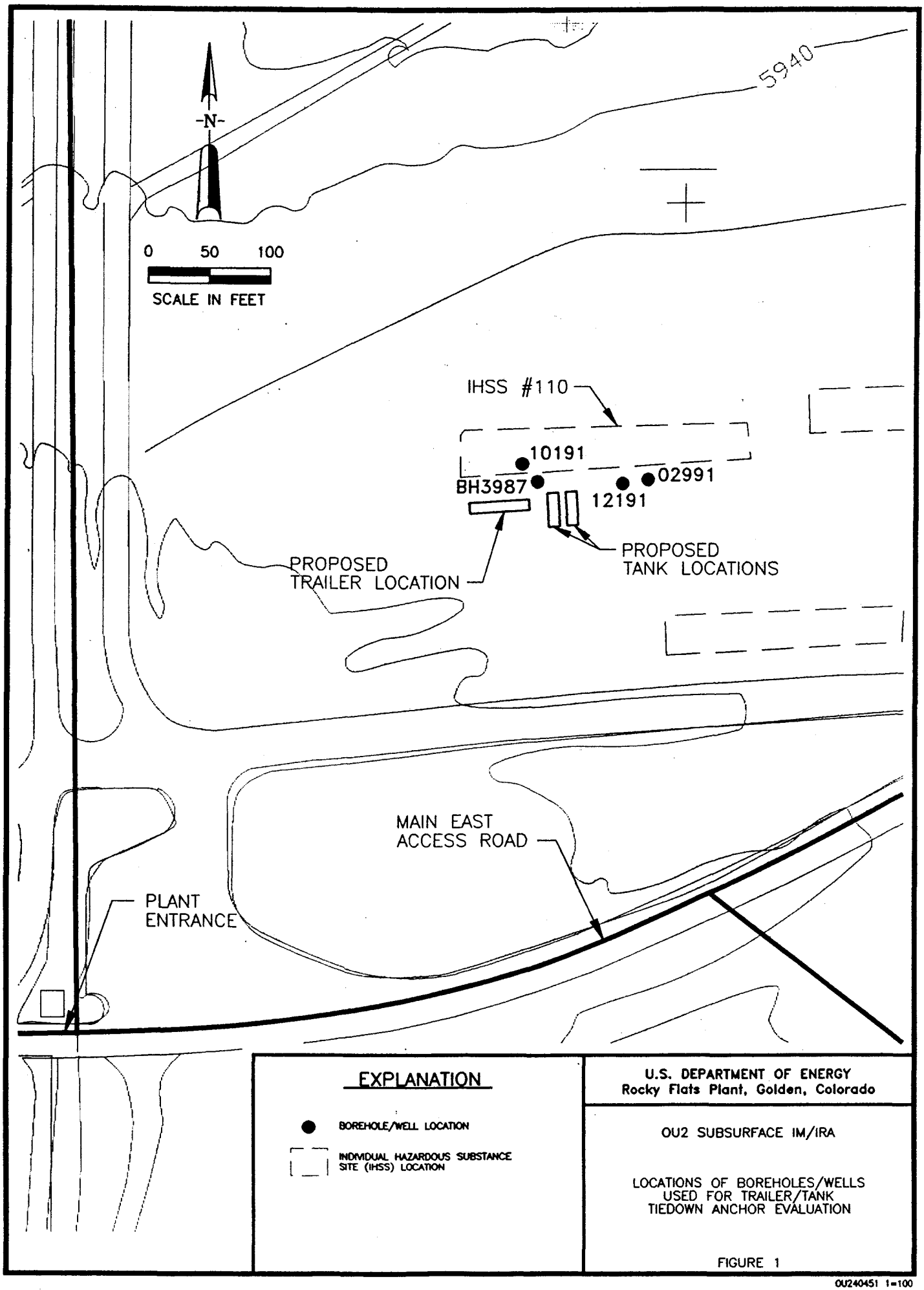
subsurface conditions encountered in the borings generally consist of medium-dense to very dense, silty to clayey, sandy gravel. The gravels tend to be fine to coarse grained and, in the vicinity of the site, some cobbles up to about six to eight inches have been encountered.

The subsurface conditions at the location of the 904 Pad waste storage tents, where D&B Drilling has installed numerous anchors, are similar to those described above for the site location. They are in the same Rocky Flats alluvium that is typified by the gravelly soils described above.

Geotechnical Engineering Considerations

The Chance anchors that D&B Drilling Inc. installed at the 904 Pad waste storage tents were also 1-3/4-inch shaft, 8-inch single helix anchors. They were installed to 1500 foot-pounds of torque and proof tested to 15 kips of pullout resistance. The depths at which the specified torque was attained varied. We understand that these anchors have performed satisfactorily.

The performance of this type of anchor can be evaluated based on an empirical correlation between drive shaft torque during installation and measured capacity. D&B Drilling proposes to install the anchors using a minimum shaft torque of 2000 foot-pounds and then proof-testing using a pullout lead of 18 kips. Considering the similarity in subsurface conditions from the areas of their previous experience to the proposed site, we believe the proposed anchors will perform satisfactorily. The proof tests should consist of holding the required test load for 3 minutes without any visually discernable anchor movement.


5940
-N-
0 50 100
SCALE IN FEET
IHSS #110
10191
BH3987
02991
12191
PROPOSED
TRAILER LOCATION
PROPOSED
TANK LOCATIONS
MAIN EAST
ACCESS ROAD
PLANT
ENTRANCE
EXPLANATION
BOREHOLE/WELL LOCATION
INDIVIDUAL HAZARDOUS SUBSTANCE
SITE (IHSS) LOCATION
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado
OU2 SUBSURFACE IM/IRA
LOCATIONS OF BOREHOLES/WELLS
USED FOR TRAILER/TANK
TIEDOWN ANCHOR EVALUATION
FIGURE 1
0U240451 1=100

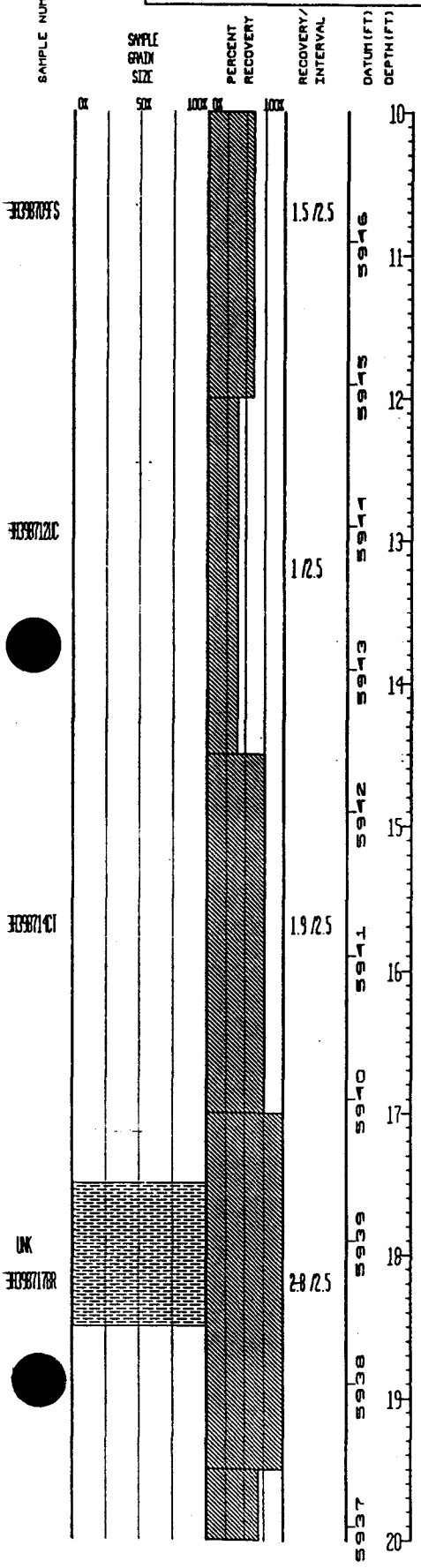
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 22	GROUND ELEVATION (FT):	5956.9	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	749760	AREA: EAST TRENCHES	CASING DIAMETER (IN):	0	GEOLOGIST:	LAA	BH39-87
EAST:	2086905	LOCATOR NUMBER: N3	BOREHOLE DIAMETER (IN):	0	DATE DRILLED:	08/12/87	

REMARKS: Hollow Stem Auger. Borhole backfilled with Portland Type I cement.

SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
H39870015	CK 50%	100% CK 100%	1.6 /2	5956	0 1			GW:	GRAVEL - predominantly light gray to medium dark gray (N7 to N4), angular, well graded, maximum size = 9 cm. long, some clay, dark reddish brown (10R 3/4), with fine to coarse grain sand, silt.
H39870021H			1.1 /2	5954	2 3			GW:	GRAVEL - predominantly light gray to med. dark gray (N7 to N4), some moderate pink (5R 7/4), angular to sub-rounded, well graded, max. size 6 cm. Some cloyey sand, light brown (5YR 5/6), well graded, fine to very coarse grained, angular to sub-rounded, some HCl reaction, some calcareous precipitation.
H39870041H			0.65 /3	5952	4 5			GW:	GRAVEL - predominantly light gray to med. dark gray (N7 to N4), angular to sub-rounded, well graded, max. size 7.5 cm. Some sand and silt, color too varied to describe accurately, fine to coarse grained, angular to sub-rounded, some calcareous mineralization, strong HCl reaction.
				5950	6 7			GW:	Some as above, cloyey sand is light brown (5YR 5/6)
H39870078H			±.65 /2.5	5948	8 9			GW:	Some as above.
				5947	10				

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 22	GROUND ELEVATION (FT):	5956.9	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	749760	AREA: EAST TRENCHES	CASING DIAMETER (IN):	0	GEOLOGIST:	LAA	BH39-87
EAST:	2086905	LOCATOR NUMBER: N9	BOREHOLE DIAMETER (IN):	0	DATE DRILLED:	08/12/87	

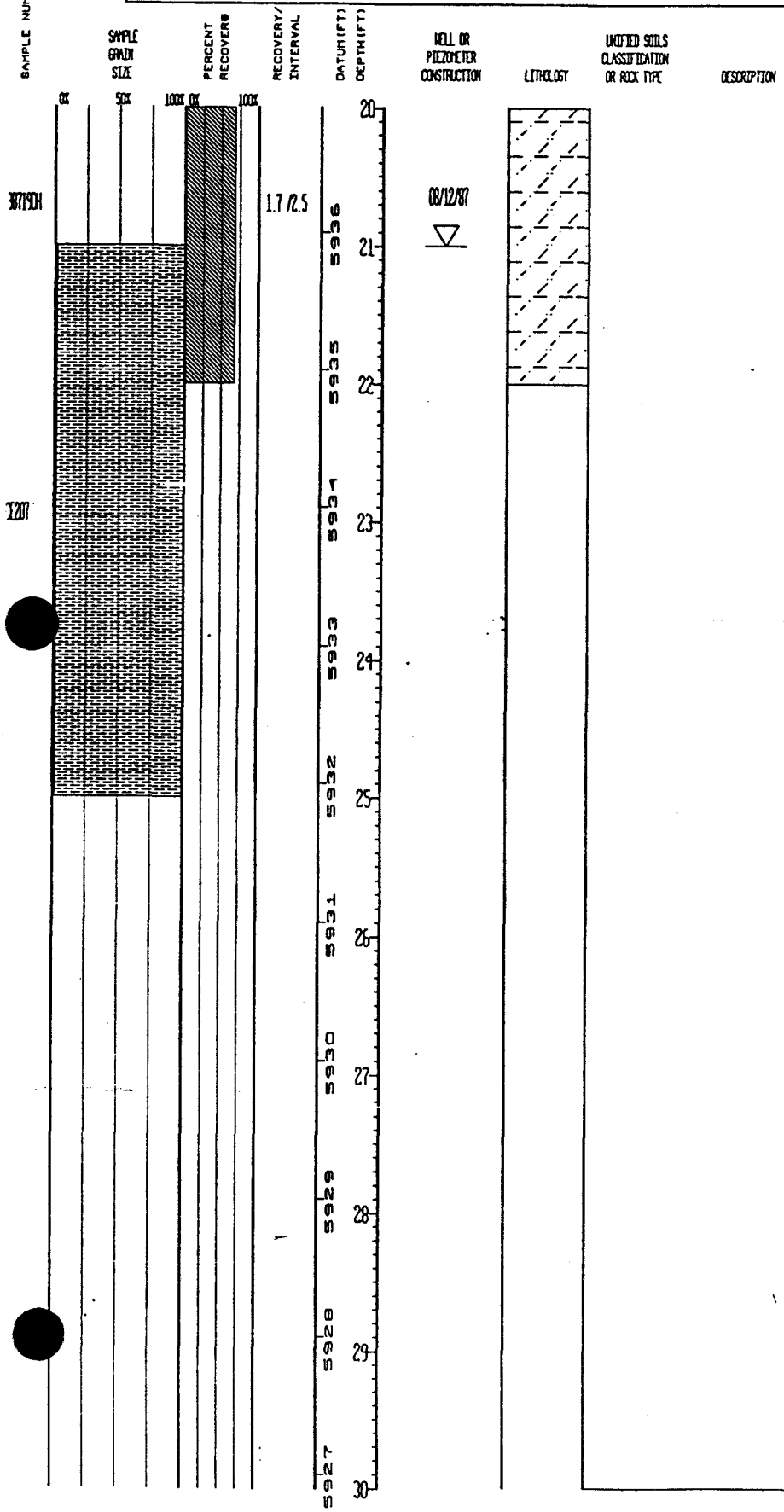
REMARKS: Hollow Stem Auger. Borhole backfilled with Portland Type I cement.



WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		GW:	Same as above.
		SILTSTONE:	Top of Bedrock Moderate brown to moderate reddish brown (10R 4/6 to 5YR 3/4), possibly convoluted and horizontal bedding, highly weathered, non to slightly friable, some mineralization in fractures. Grades to grayish orange clayey siltstone to fine sandstone (10YR 7/4), looks like thin horizontal bedding, weathered, moderately friable, very fine grained, well sorted.
		CLAYEY SILTSTONE:	Same as above, also has dark yellowish orange coloring.
		CLAYEY SILTSTONE:	Same as above, trace of carbonaceous material throughout matrix.

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 22	GROUND ELEVATION (FT):	5956.9	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	749760	AREA: EAST TRENCHES	CASING DIAMETER (IN):	0	GEOLOGIST:	LAA	BH39-87
EAST:	2086905	LOCATOR NUMBER: N9	BOREHOLE DIAMETER (IN):	0	DATE DRILLED:	08/12/87	

REMARKS: Hollow Stem Auger. Borehole backfilled with Portland Type I cement.



STATE PLANE COORDINATE: NORTH 249777.43 EAST 2088970.3 | TOTAL DEPTH (FT): 57.9 | AREA: NE TRENCHES | LOCATOR NUMBER: H13 | GROUND ELEVATION (FT): 5956.30 | CASING DIAMETER (IN): 2.0 | BOREHOLE DIAMETER (IN): 10.0 | PROJECT NUMBER: OU2RI | GEOLOGIST: L.A. GUST | DATE DRILLED: 11/25/91

LOG OF BORING NUMBER: 02991

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 35.0 FT. - 30.0 FT. BACKFILL MATERIAL: BENTONITE 57.9 FT. - 54.0 FT.

DEPTH (FT)	SAMPLE NUMBER	CHEMICAL/GRADATIONAL	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/INTERVAL	DATUM (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
0						5956				Top soil, start of boring at 0.90 ft.
					0.00 /0.90				CL	Sandy Clay with some gravel - dusky red (5R3/4), medium- to fine-grained sand, average size gravel 1/2" diameter, sub-angular to sub-rounded, poorly graded, low plasticity, dominant lithology sand quartz with some rock fragments and trace dark minerals, gravel primarily quartz and quartzite, no apparent bedding, moist, some roots present. 8% gravel, 27% sand, 4% silt, 61% clay.
1						5955				
					0.50 /2.00					No recovery for this interval.
2						5954			GW	Sandy Gravel - moderate brown (5YR4/4), maximum size gravel 2" diameter, average 1" diameter, coarse- to fine-grained sand, well graded, angular to sub-angular gravel, sub-angular sand, low plasticity, gravel primarily quartzite with trace granite, dominant lithology sand rock fragments with abundant quartz and some dark minerals and trace mica and K-spar, some iron staining on grains, some caliche throughout, no apparent bedding, moist. 69% gravel, 26% sand, 3% silt, 2% clay.
3						5953				
					0.60 /2.00					No recovery for this interval.
4						5952				
5						5951			GW	Sandy Gravel - moderate brown (5YR4/4), as described above.
					0.40 /2.00					No recovery for this interval.
6						5950				
									GW	Sandy Gravel - moderate brown (5YR4/4), as described above.
7						5949			GC	Sandy Gravel with some clay - pinkish gray (5YR8/1), maximum size gravel greater than 2" diameter, average 1" diameter, coarse- to fine-grained sand, well graded, sub-angular, low plasticity, gravel primarily quartzite with some granite, dominant lithology sand quartz with some rock fragments and trace dark minerals, abundant caliche throughout and coating on gravel, no apparent bedding, dry. 66% gravel, 20% sand, 2% silt, 12% clay.
					1.10 /2.00					No recovery for this interval.
8						5948				
9						5947			GC	Sandy Gravel with some clay - pinkish gray (5YR8/1), as described above, greenish gray (5G6/1) clay at 9.5-9.7'.
					1.00 /2.00				GW	Sandy Gravel - moderate brown (5YR4/4), as described below.
10										

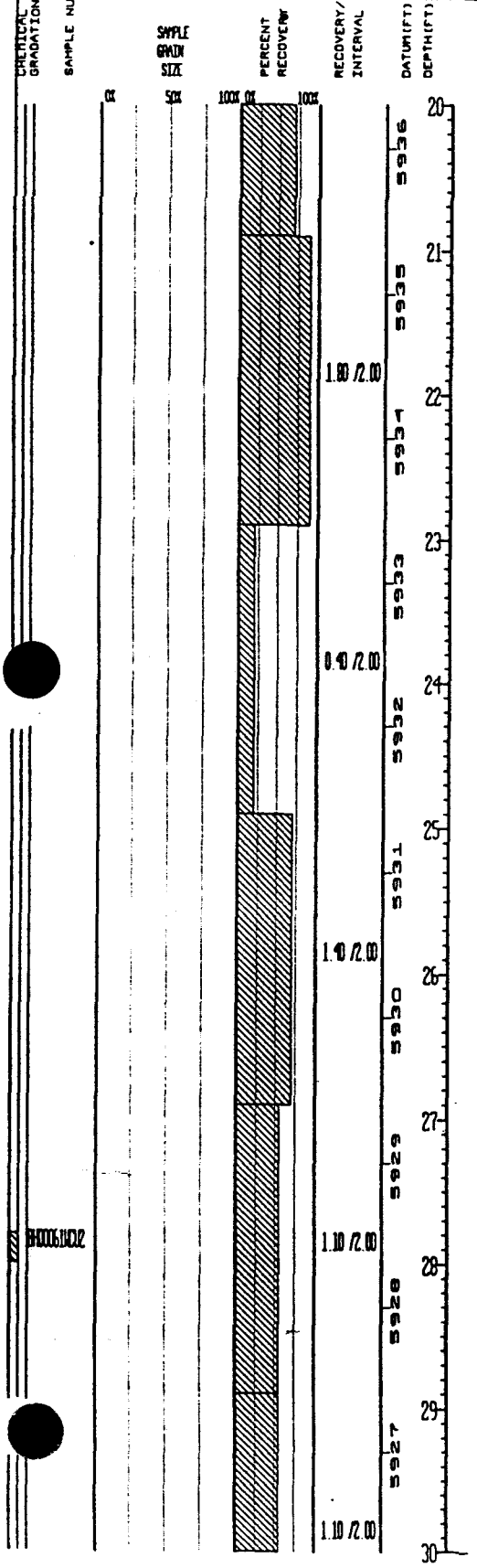
STATE PLANE COORDINATE		TOTAL DEPTH (FT) 57.9	GROUND ELEVATION (FT)	5956.30	PROJECT NUMBER	0127I	LOG OF BORING NUMBER
NORTH	749969.27	AREA NE TRENCHES	CASING DIAMETER (IN)	2.0	GEOLOGIST	L.A. GUST	02991
EAST	2087504.28	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN)	10.0	DATE DRILLED	11/25/91	

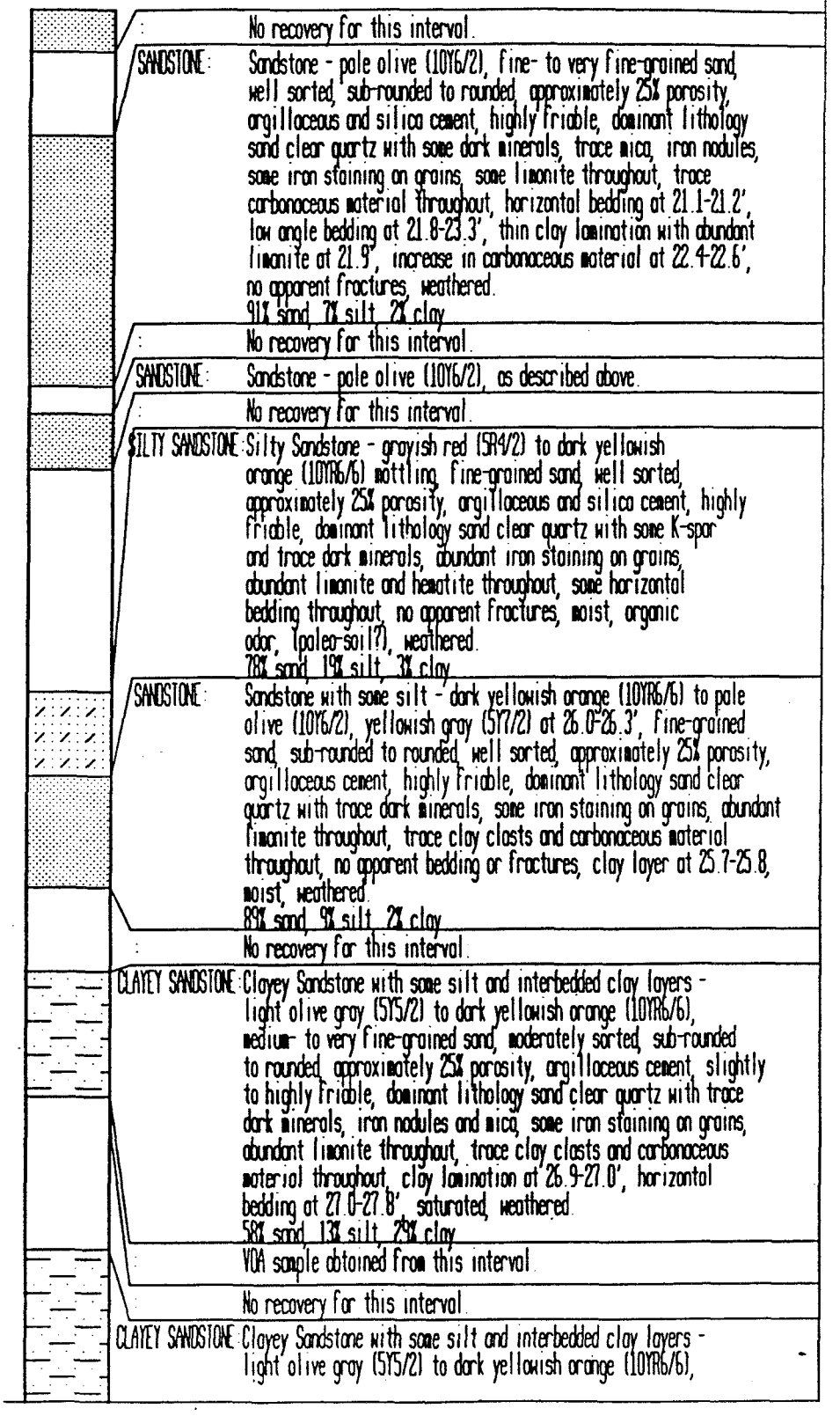
REMARKS HOLLOW STEM AUGER BENTONITE SEAL 35.0 FT - 30.0 FT BACKFILL MATERIAL BENTONITE 57.9 FT - 54.0 FT

DEPTH (FT)	CHEMICAL/ GRADATIONAL	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
10			0% 50%	100% 0%	100%	5946				No recovery for this interval.
11						5945			GW	Sandy Gravel - moderate brown (5YR4/4), maximum size gravel greater than 2" diameter, average 1" diameter, coarse- to fine-grained sand, well graded, sub-angular sand, angular to sub-rounded gravel, low plasticity, gravel primarily quartzite with some granite, dominant lithology sand rock fragments with abundant quartz and some dark minerals and trace K-spar and mica, some iron staining throughout, no apparent bedding, moist. 64% gravel, 28% sand, 2% silt, 6% clay.
12					0.50/2.00	5944				No recovery for this interval.
13						5943			GW	Sandy Gravel - moderate brown (5YR4/4), as described above
14					0.70/2.00	5942				No recovery for this interval.
15						5941			GW	Sandy Gravel - moderate brown (5YR4/4), as described above
										No recovery for this interval. Based on nearby well control, top of bedrock placed at 15.8 ft
16					0.70/2.00	5940			SILTY SANDSTONE	Silty Sandstone - pale olive (10Y6/2) to dusky yellow (5Y6/4), fine- to very fine-grained sand, well sorted, sub-angular to sub-rounded, approximately 20% porosity, argillaceous cement, moderately to highly friable, dominant lithology sand clear quartz with some dark minerals and trace mica, trace iron staining on grains, some limonite throughout, trace clay clasts and carbonaceous material throughout, very thin laminations of silt, clay and sand with some low angle bedding at 17.3-17.8', no apparent fractures, dry to moist, weathered. 57% sand, 39% silt, 4% clay.
17						5939				
		BH0059U02			1.10/2.00					VOA sample obtained from this interval.
18						5938				No recovery for this interval.
									SILTY SANDSTONE	Silty Sandstone - pale olive (10Y6/2) to dusky yellow (5Y6/4), as described above, caliche clast at 18.9, very thin laminations of silt, clay and sand with some low angle bedding at 18.9-19.0'
19						5937				
					1.40/2.00				SANDSTONE	Sandstone - pale olive (10Y6/2), as described below, horizontal bedding at 19.5-19.7'
20										

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 57.9	GROUND ELEVATION (FT):	5956.30	PROJECT NUMBER:	0UZRI	LOG OF BORING NUMBER:
NORTH:	749969.27	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST	02991
EAST:	2087504.28	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/25/91	

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 35.0 FT. - 30.0 FT. BACKFILL MATERIAL: BENTONITE 57.9 FT. - 54.0 FT.

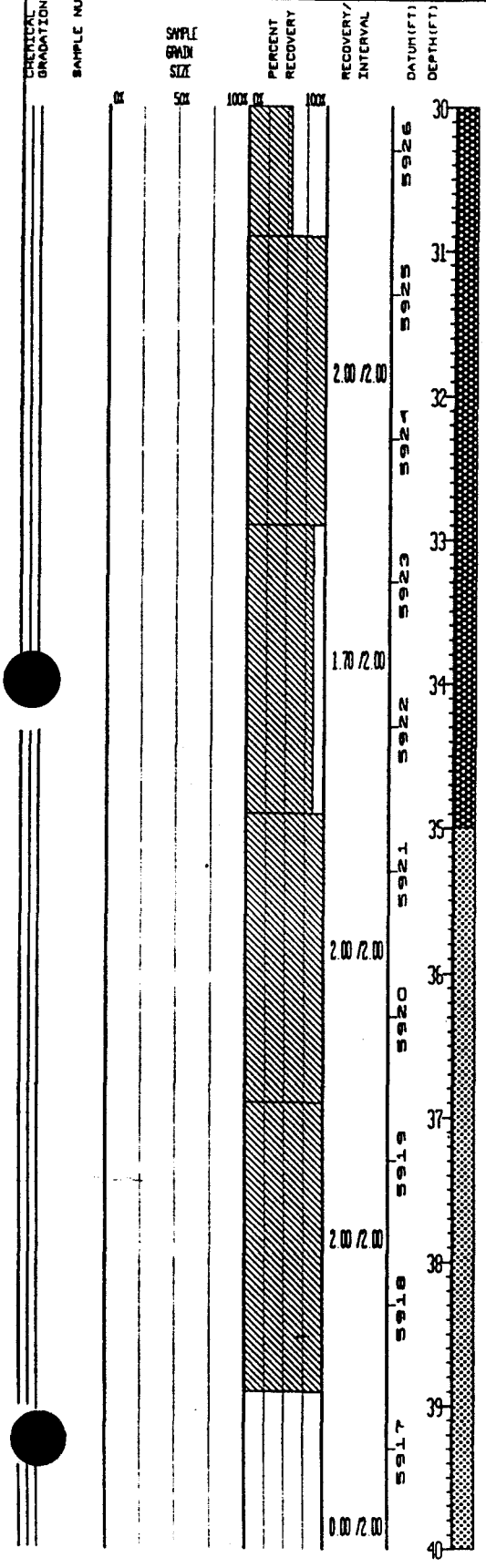




UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
	No recovery for this interval.
SANDSTONE	Sandstone - pale olive (10Y6/2), fine- to very fine-grained sand, well sorted, sub-rounded to rounded, approximately 25% porosity, argilloceous and silica cement, highly friable, dominant lithology sand clear quartz with some dark minerals, trace mica, iron nodules, some iron staining on grains, some limonite throughout, trace carbonaceous material throughout, horizontal bedding at 21.1-21.2', low angle bedding at 21.8-23.3', thin clay lamination with abundant limonite at 21.9', increase in carbonaceous material at 22.4-22.6', no apparent fractures, weathered. 91% sand, 7% silt, 2% clay
	No recovery for this interval.
SANDSTONE	Sandstone - pale olive (10Y6/2), as described above.
	No recovery for this interval.
SILTY SANDSTONE	Silty Sandstone - grayish red (5R4/2) to dark yellowish orange (10YR6/6) mottling, fine-grained sand, well sorted, approximately 25% porosity, argilloceous and silica cement, highly friable, dominant lithology sand clear quartz with some K-spar and trace dark minerals, abundant iron staining on grains, abundant limonite and hematite throughout, some horizontal bedding throughout, no apparent fractures, moist, organic odor, (paleo-soil?), weathered. 78% sand, 19% silt, 3% clay
SANDSTONE	Sandstone with some silt - dark yellowish orange (10YR6/6) to pale olive (10Y6/2), yellowish gray (5Y7/2) at 26.0-26.3', fine-grained sand, sub-rounded to rounded, well sorted, approximately 25% porosity, argilloceous cement, highly friable, dominant lithology sand clear quartz with trace dark minerals, some iron staining on grains, abundant limonite throughout, trace clay clasts and carbonaceous material throughout, no apparent bedding or fractures, clay layer at 25.7-25.8, moist, weathered. 88% sand, 9% silt, 2% clay
	No recovery for this interval.
CLAYEY SANDSTONE	Clayey Sandstone with some silt and interbedded clay layers - light olive gray (5Y5/2) to dark yellowish orange (10YR6/6), medium- to very fine-grained sand, moderately sorted, sub-rounded to rounded, approximately 25% porosity, argilloceous cement, slightly to highly friable, dominant lithology sand clear quartz with trace dark minerals, iron nodules and mica, some iron staining on grains, abundant limonite throughout, trace clay clasts and carbonaceous material throughout, clay lamination at 26.9-27.0', horizontal bedding at 27.0-27.8', saturated, weathered. 58% sand, 13% silt, 29% clay
	VOA sample obtained from this interval.
	No recovery for this interval.
CLAYEY SANDSTONE	Clayey Sandstone with some silt and interbedded clay layers - light olive gray (5Y5/2) to dark yellowish orange (10YR6/6),

STATE PLANE COORDINATE:	TOTAL DEPTH (FT): 57.9	GROUND ELEVATION (FT):	5956.30	PROJECT NUMBER:	002RI	LOG OF BORING NUMBER:	
NORTH: 749969.27	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST		02991
EAST: 2087504.28	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/25/91		

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 35.0 FT. - 30.0 FT. BACKFILL MATERIAL: BENTONITE 57.9 FT - 54.0 FT.



DESCRIPTION

as described above, clay laminations at 28.9-29.5' and 29.6-30.0', low angle bedding at 28.9-29.5', abundant carbonaceous material at 29.3', abundant iron nodules, limonite and some hematite at 29.5-29.6' with organic odor.

No recovery for this interval.

CLAYEY SANDSTONE: Clayey Sandstone with some silt and interbedded clay layers - light olive gray (5Y5/2) to dark yellowish orange (10YR6/6), as described above, clay laminations at 30.9-31.7', horizontal bedding at 30.9-31.7', 10 degree healed fracture with iron at 31.7'.

SILTY SANDSTONE: Silty Sandstone with some clay - dusky yellow (5Y6/4), fine- to very fine-grained sand, well sorted, sub-rounded, approximately 20% porosity, argilloceous cement, moderately friable, dominant lithology sand clear quartz with trace dark minerals, abundant iron staining on grains, some limonite throughout, trace carbonaceous material throughout, low bedding at 31.7-32.1', thin clay laminations at 32.4-32.5', no apparent fractures, saturated, weathered.
57% sand, 34% silt, 9% clay.

CLAYEY SANDSTONE: Clayey Sandstone with some silt and interbedded clay layers - dusky yellow (5Y6/4) to light olive gray (5Y5/2), fine- to very fine-grained sand, well sorted, sub-rounded, approximately 18% porosity, argilloceous cement, moderately friable, dominant lithology sand clear quartz with trace dark minerals, some iron staining on grains, abundant limonite throughout, some clay clasts throughout, wood fragments at 34.0', low angle bedding throughout, clay layers at 33.0-33.1' and 33.5-33.6', no apparent fractures, moist, weathered.

SANDSTONE: Sandstone - dusky yellow (5Y6/4), as described below

No recovery for this interval.

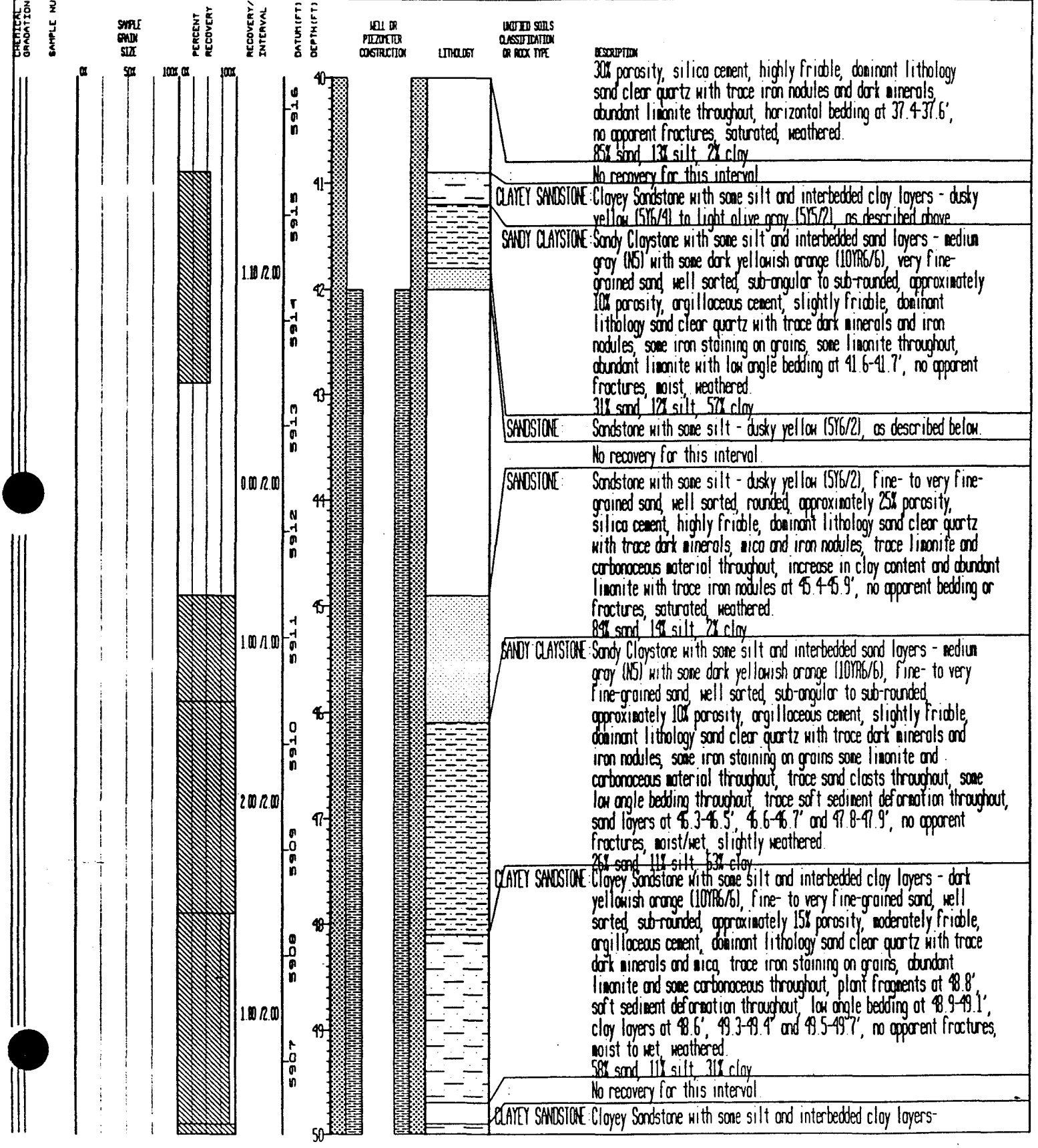
SANDSTONE: Sandstone - dusky yellow (5Y6/4), fine- to very fine-grained sand, well sorted, rounded, approximately 30% porosity, silica cement, highly friable, dominant lithology sand clear quartz with trace dark minerals, trace hematite and carbonaceous material throughout, some limonite throughout, horizontal bedding at 35.2-36.0, no apparent fractures, saturated, slightly weathered.
91% sand, 8% silt, 1% clay.

CLAYEY SANDSTONE: Clayey Sandstone with some silt and interbedded clay layers - dusky yellow (5Y6/4) to light olive gray (5Y5/2), very fine-grained sand, well sorted, sub-angular, approximately 15% porosity, argilloceous cement, slightly to moderately friable, dominant lithology sand clear quartz with some dark minerals and trace mica and iron nodules, some iron staining on grains, some limonite throughout, low angle bedding at 36.0-36.4', cross bedding up to 30 degrees at 36.4-36.6', clay laminations at 36.8-36.9' and 37.9-37.5', dewatering structure at 36.1-36.3', no apparent fractures, moist to saturated, weathered.
52% sand, 19% silt, 29% clay.

SANDSTONE: Sandstone with some silt - dusky yellow (5Y6/2), fine- to very fine-grained sand, well sorted, rounded, approximately

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 57.9	GROUND ELEVATION (FT):	5956.30	PROJECT NUMBER:	0128I	LOG OF BORING NUMBER:
NORTH:	749569.27	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST	02991
EAST:	2087504.28	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/25/91	

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 35.0 FT - 30.0 FT BACKFILL MATERIAL: BENTONITE 57.9 FT. - 54.0 FT.



STATE PLANE COORDINATE:	TOTAL DEPTH (FT): 57.9	GROUND ELEVATION (FT):	5956.30	PROJECT NUMBER:	0221	LOG OF BORING NUMBER:	
NORTH: 749969.27	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST		02991
EAST: 2087504.28	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/25/91		

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 35.0 FT. - 30.0 FT. BACKFILL MATERIAL: BENTONITE 57.9 FT. - 54.0 FT.

CHEMICAL ANALYSIS / GRADATIONAL	SAMPLE NUMBER	SAMPLE DEPTH	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY / INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		0%	50%	100% 0% 100%			50				dark yellowish orange (10YR6/6), as described above.
					2.00 /2.00	5906				SANDY CLAYSTONE	Sandy Claystone with some silt and interbedded sand layers - medium dark gray (N4), very fine-grained sand, well sorted, sub-angular, approximately 10% porosity, argillaceous cement, slightly friable, dominant lithology sand clear quartz with trace dark minerals and iron nodules, trace iron staining on grains, some limonite and carbonaceous material throughout, trace iron nodules and sand clasts throughout, wood fragments at 50.3', sand layer at 50.6-50.8', no apparent bedding or fractures, moist to saturated, slightly weathered. 27% sand, 7% silt, 66% clay.
						5905	51				
							52				
					2.00 /2.00	5904				SILTY CLAYSTONE	Silty Claystone - medium dark gray (N4), as described below.
						5903	53				
	0100032002										VOA sample obtained from this interval
						5902	54			SILTY CLAYSTONE	Silty Claystone - medium dark gray (N4), very fine-grained sand, well sorted, sub-angular, approximately 5% porosity, argillaceous cement, non-friable, dominant lithology sand clear quartz with trace dark minerals; trace iron staining on grains, trace limonite throughout, some clay clasts throughout, trace horizontal bedding throughout, 45 degree fractures with slickensides, unweathered. 26% silt, 3% sand, 71% clay.
					1.80 /2.00	5901	55				
											No recovery for this interval.
						5900	56			SILTY CLAYSTONE	Silty Claystone - medium dark gray (N4), as described above.
					2.00 /2.00	5899	57				
						5898	58				Total depth at 57.9 ft.
						5897	59				
							60				

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 36.9	GROUND ELEVATION (FT):	5956.49	PROJECT NUMBER:	0121	LOG OF BORING NUMBER:
NORTH:	749966.04	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST	12191
EAST:	2087483.35	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/27/91	

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 15.9 FT - 12.7 FT OFFSET TO WELL 02991, CUTTING SAMPLES WERE COLLECTED EVERY 2 FEET WITH THE EXCEPTION OF 15.0-16.8', AND 27.4-28.1'

CHEMICAL OR GRADATIONAL SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM(FT)	DEPTH(FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
	0% 50% 100%	0% 100%							Top soil, start of boring at 0.90 ft.
			0.00 /0.90	5956	0			GC	Sandy Gravel with some clay - grayish black (N2), maximum size gravel 1 1/2" diameter, average 3/4" diameter, coarse- to fine-grained sand, poorly graded, sub-rounded gravel, sub-angular sand, low plasticity, gravel primarily quartzite with some granite, dominant lithology sand quartz with some rock fragments and trace mica, dark minerals and K-spar, no apparent bedding, moist. 72% gravel, 19% sand, 2% silt, 7% clay.
			0.00 /2.00	5955	1				
					2				
				5954				GC	Sandy Gravel with some clay - moderate brown (5YR3/4), maximum size gravel 1" diameter, average 1/2" diameter, coarse- to fine-grained sand, well graded, sub-rounded gravel, sub-angular to sub-rounded sand, low to medium plasticity, gravel primarily quartzite, dominant lithology sand quartz with some rock fragments and trace dark minerals and mica, no apparent bedding, moist. 68% gravel, 20% sand, 2% silt, 10% clay.
			0.00 /2.00	5953	3				
					4				
				5952				GW	Sandy Gravel - moderate brown (5YR4/4), maximum size gravel 1 1/2" diameter, average 1" diameter, coarse- to fine-grained sand, well graded, sub-angular, low plasticity, gravel primarily quartzite with some granite, dominant lithology sand rock fragments with abundant quartz and trace dark minerals, mica and K-spar, abundant caliche throughout, no apparent bedding, dry. 67% gravel, 29% sand, 1% silt, 3% clay.
			0.00 /2.00	5951	5				
					6				
				5950					
			0.00 /2.00	5949	7				
					8				
				5948					
			0.00 /2.00	5947	9				
					10				

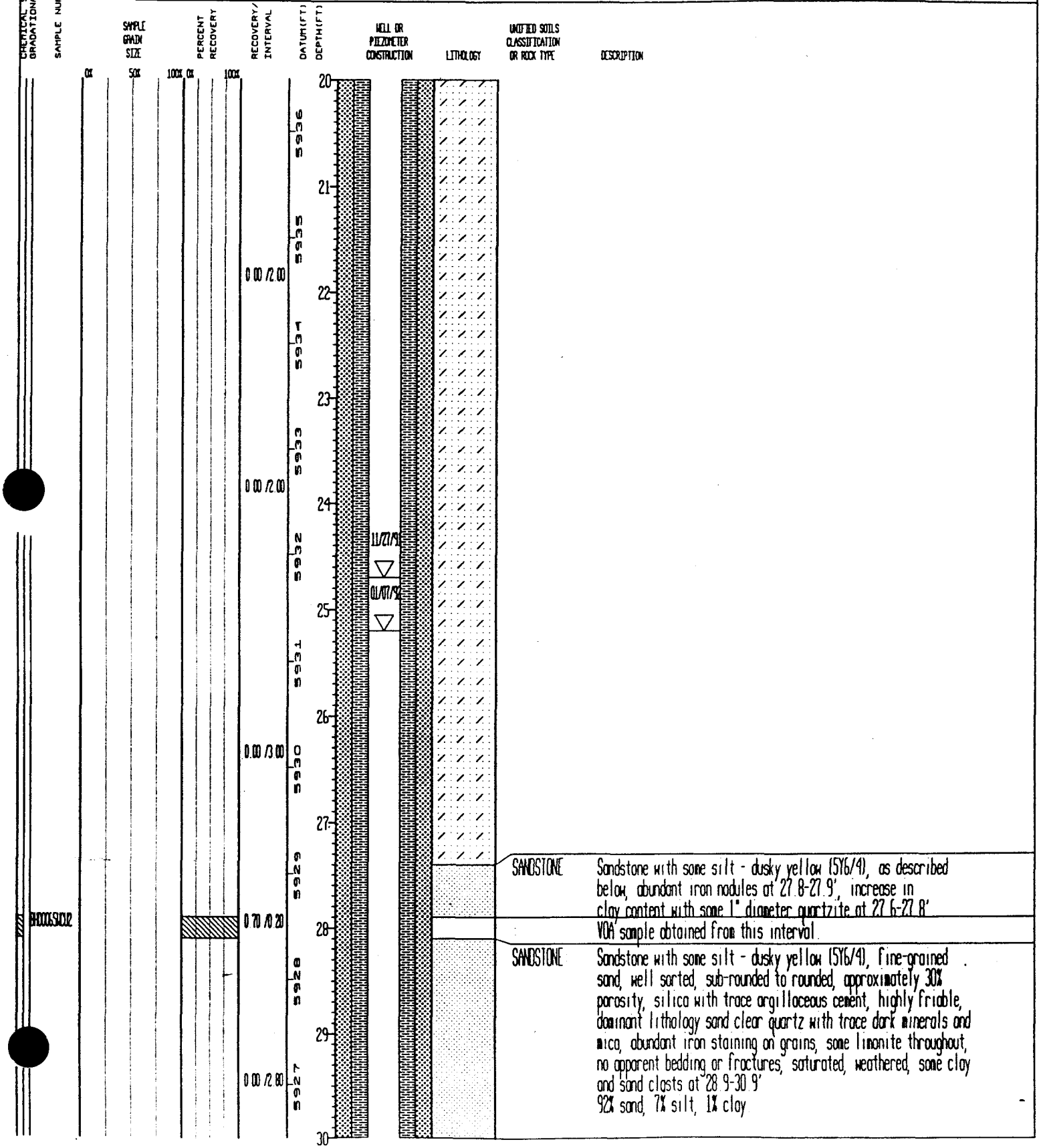
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 36.9	GROUND ELEVATION (FT):	5956.49	PROJECT NUMBER:	00281	LOG OF BORING NUMBER
NORTH:	749966.04	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST	12191
EAST:	2087483.35	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED:	11/27/91	

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 15.9 FT. - 12.7 FT. OFFSET TO WELL 02991, CUTTING SAMPLES WERE COLLECTED EVERY 2 FEET WITH THE EXCEPTION OF 15.0-16.8', AND 27.4-28.1'.

DEPTH	CRITICAL SIZE GRADATIONAL	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
			0% 50% 100%	0% 100%			10				
						5946					
							11			GW	Sandy Gravel - moderate brown (5YR4/4), maximum size gravel 1" diameter, average 1/4" diameter, coarse- to fine-grained sand, well graded, sub-rounded, low plasticity, gravel primarily quartzite with some granite and trace quartz, dominant lithology sand quartz with some rock fragments and dark minerals and trace mica, K-spar and pyrite, no apparent bedding, dry to moist. 58% gravel, 38% sand, 3% silt, 1% clay. Top of bedrock at 15.7 ft.
						5945					
					0.00 /2.00		12				
						5944					
							13				
					0.00 /2.10	5943					
							14				
						5942					
							15				
						5941					
					1.80 /1.80		16			SILTY SANDSTONE	Silty Sandstone - pale olive (10Y6/2) to dusky yellow (5Y6/4), as described below.
		BH00534D2				5940					VOA sample obtained from this interval.
							17			SILTY SANDSTONE	Silty Sandstone - pale olive (10Y6/2) to dusky yellow (5Y6/4), fine- to very fine-grained sand, well sorted, sub-angular to sub-rounded, approximately 20% porosity, argillaceous cement, moderately to highly friable, dominant lithology sand clear quartz with some dark minerals and trace mica, trace iron staining on grains, some limonite throughout, trace horizontal bedding throughout, no apparent fractures, dry to moist, weathered 64% sand, 32% silt, 4% clay.
					0.00 /2.10	5939					
							18				
						5938					
							19				
					0.00 /2.00	5937					
							20				

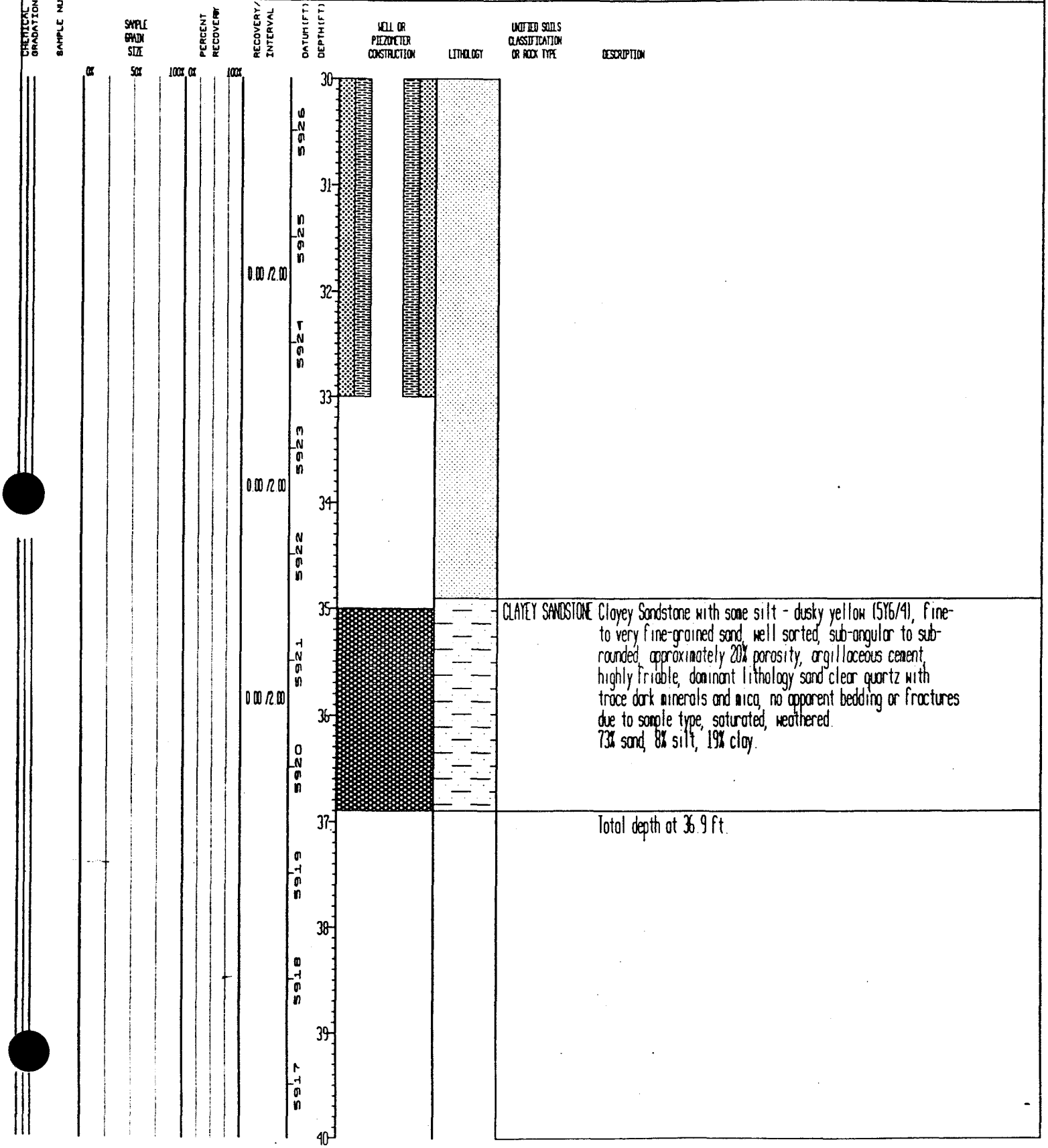
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 36.9	GROUND ELEVATION (FT):	5956.49	PROJECT NUMBER:	0UZRI	LOG OF BORING NUMBER:
NORTH:	749966.04	AREA: NE TRENCHES	CASING DIAMETER (IN):	2.0	GEOLOGIST:	L.A. GUST	12191
EAST:	2087483.35	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN):	10.0	DATE DRILLED	11/27/91	

REMARKS: HOLLOW STEM AUGER. BENTONITE SEAL 15.9 FT. - 12.7 FT. OFFSET TO WELL 02991, CUTTING SAMPLES WERE COLLECTED EVERY 2 FEET WITH THE EXCEPTION OF 15.0-16.8', AND 27.4-28.1'.



STATE PLANE COORDINATE		TOTAL DEPTH (FT) 36.9	GROUND ELEVATION (FT)	5956.93	PROJECT NUMBER	0121	LOG OF BORING NUMBER
NORTH	749966.04	AREA NE TRENCHES	CASING DIAMETER (IN)	2.0	GEOLOGIST	L.A. GUST	12191
EAST	2087483.35	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN)	10.0	DATE DRILLED	11/27/91	

REMARKS HOLLOW STEM AUGER. BENTONITE SEAL 15.9 FT. - 12.7 FT. OFFSET TO WELL 02991, CUTTING SAMPLES WERE COLLECTED EVERY 2 FEET WITH THE EXCEPTION OF 15.0-16.8', AND 27.4-28.1'.

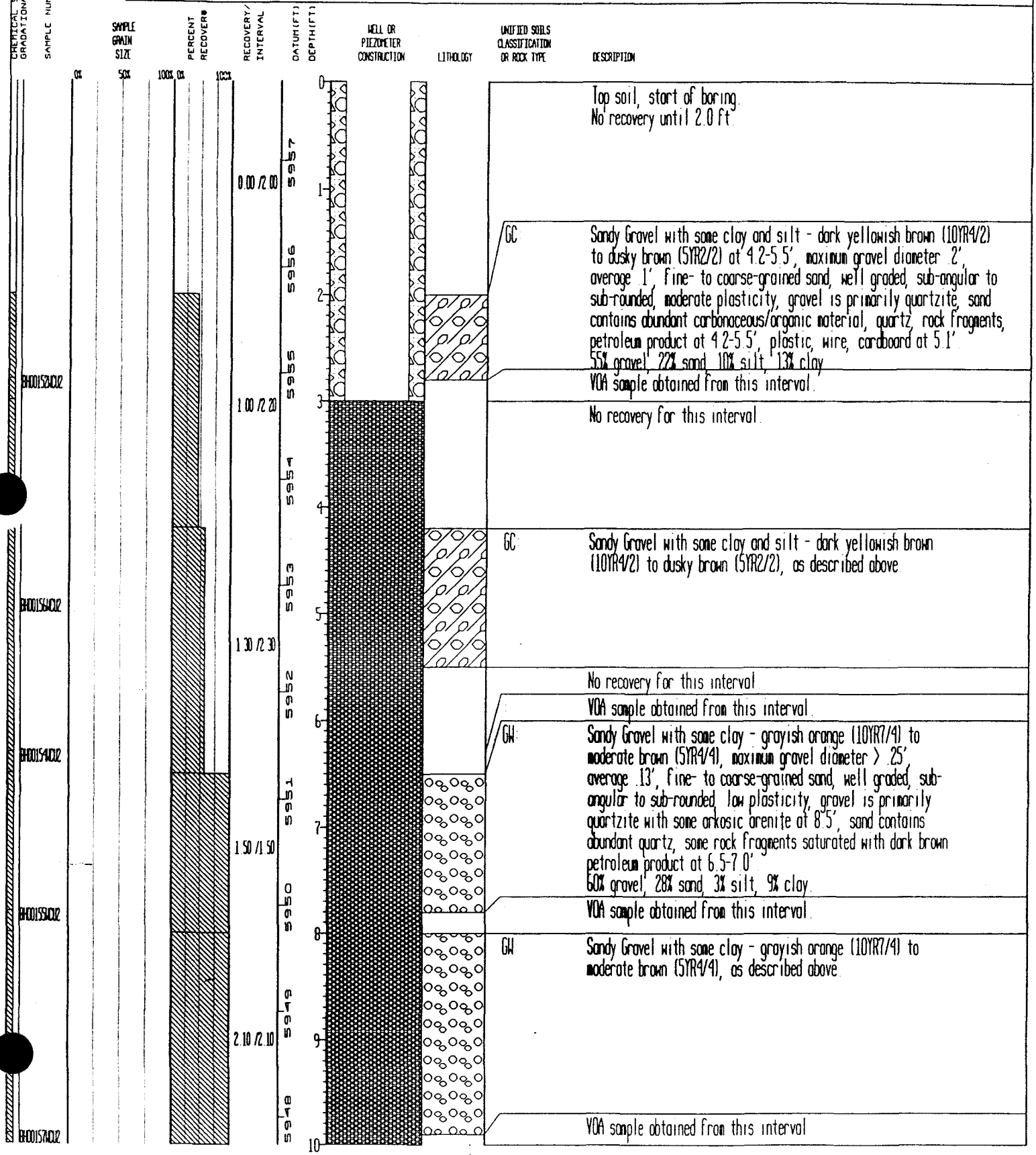


CLAYEY SANDSTONE Clayey Sandstone with some silt - dusky yellow (5Y6/4), fine- to very fine-grained sand, well sorted, sub-angular to sub-rounded, approximately 20% porosity, argilloceous cement, highly friable, dominant lithology sand clear quartz with trace dark minerals and mica, no apparent bedding or fractures due to sample type, saturated, weathered.
73% sand, 8% silt, 19% clay.

Total depth at 36.9 ft.

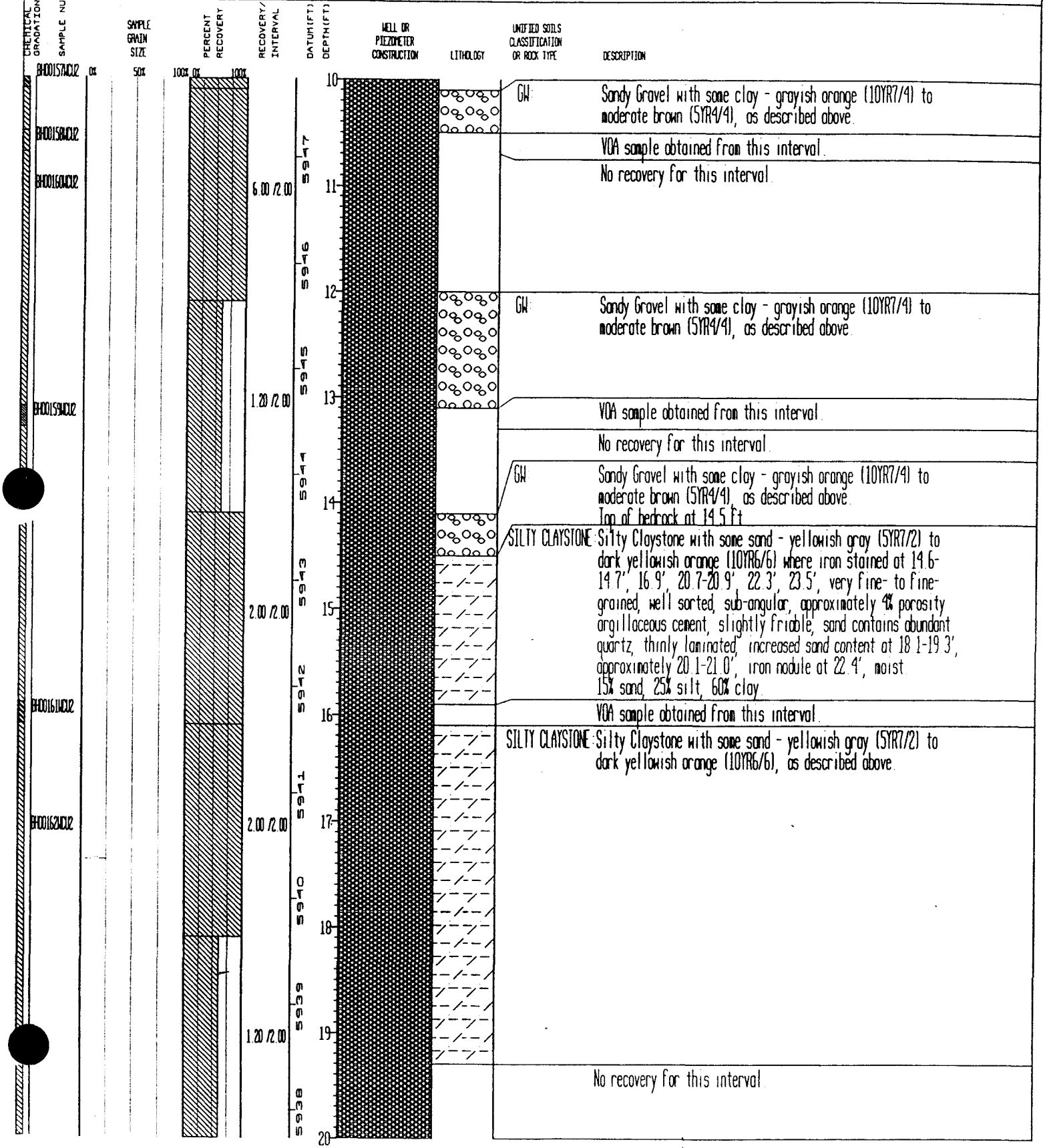
STATE PLANE COORDINATE	TOTAL DEPTH (FT) 5.4 0	GROUND ELEVATION (FT)	5957 74	PROJECT NUMBER	002/RI	LOG OF BORING NUMBER	
NORTH 749980 35	AREA NE TRENCHES	CASING DIAMETER (IN)		GEOLOGIST	J.P. O'BRIEN	10191	
EAST 2087401 67	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN)	6 5	DATE DRILLED	12/02/91		

REMARKS: GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED, FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE



STATE PLANE COORDINATE	TOTAL DEPTH (FT) 54 0	GROUND ELEVATION (FT) 5957 74	PROJECT NUMBER	002/R1	LOG OF BORING NUMBER	
NORTH 749980 35	AREA NE TRENCHES	CASING DIAMETER (IN)	GEOLOGIST	J P O'BRIEN	10191	
EAST 2087401 67	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN) 6 5	DATE DRILLED	12/02/91		

REMARKS: GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED, FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE



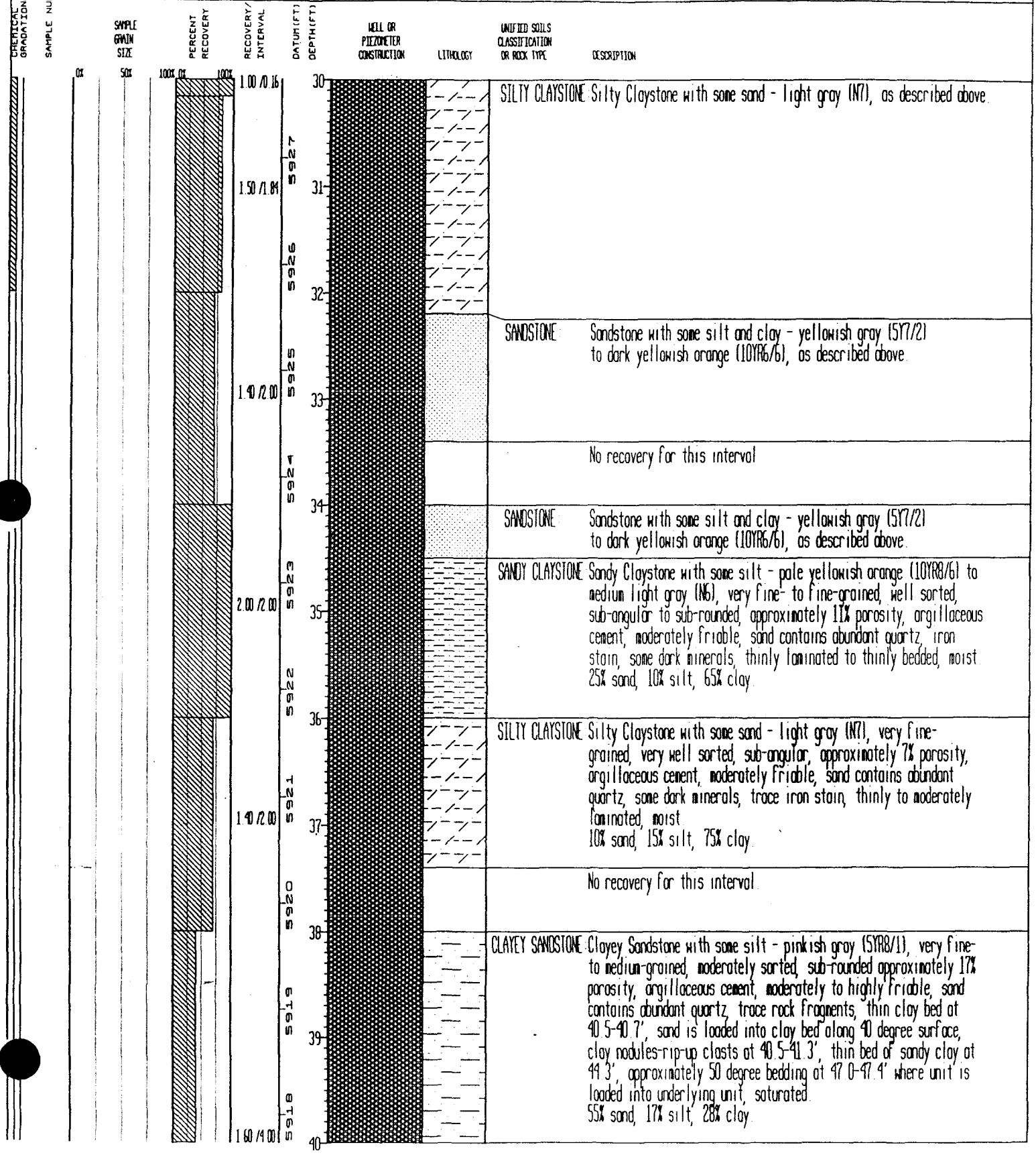
STATE PLANE COORDINATE		TOTAL DEPTH (FT) 54.0	GROUND ELEVATION (FT)	5957.74	PROJECT NUMBER	002/RI	LOG OF BORING NUMBER
NORTH	749980.35	AREA NE TRENCHES	CASING DIAMETER (IN)		GEOLOGIST	J.P. O'BRIEN	10191
EAST	2087401.67	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN)	6.5	DATE DRILLED	12/02/91	

REMARKS GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED, FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE

CHEMICAL SAM. GRADATIONAL S.	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		0% 50% 100%	0% 100%			20				
				1.00 /1.90	5937	21			SILTY CLAYSTONE	Silty Claystone with some sand - yellowish gray (5YR7/2) to dark yellowish orange (10YR6/6), as described above.
										No recovery for this interval.
					5936	22			SILTY CLAYSTONE	Silty Claystone with some sand - yellowish gray (5YR7/2) to dark yellowish orange (10YR6/6), as described above.
	BH001640202			2.00 /2.00	5935	23				
					5934	24			SANDSTONE	Sandstone with some silt and clay - yellowish gray (5Y7/2) to dark yellowish orange (10YR6/6), very fine- to medium-grained, moderately sorted, sub-angular to rounded, approximately 25% porosity, argillaceous cement, highly friable, abundant frosted quartz, trace dark minerals, thinly to thickly laminated at 24.6-28.0', unconsolidated at 28.0-32.6', iron stain at 26.5-26.8', 34.0-34.5', 32.6-33.1', moist at 24.6-28.0', saturated at 28.0-34.5' 80% sand, 12% silt, 8% clay
				1.00 /2.00	5933	25				
					5932	26				No recovery for this interval.
									SANDSTONE	Sandstone with some silt and clay - yellowish gray (5Y7/2) to dark yellowish orange (10YR6/6), as described above.
				1.00 /2.00	5931	27				No recovery for this interval
					5930	28			SANDSTONE	Sandstone with some silt and clay - yellowish gray (5Y7/2) to dark yellowish orange (10YR6/6), as described above.
	BH001653202			2.00 /2.00	5929	29				
	BH001664202				5928	30				VOA sample obtained from this interval

STATE PLANE COORDINATE		TOTAL DEPTH (FT): 54.0	GROUND ELEVATION (FT)	5957.74	PROJECT NUMBER:	002/R1	LOG OF BORING NUMBER
NORTH	749980.35	AREA: NE TRENCHES	CASING DIAMETER (IN)		GEOLOGIST	J.P. O'BRIEN	10191
EAST	2087401.67	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN)	6.5	DATE DRILLED:	12/02/91	

REMARKS: GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED; FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE



SILTY CLAYSTONE: Silty Claystone with some sand - light gray (N7), as described above.

SANDSTONE: Sandstone with some silt and clay - yellowish gray (5Y7/2) to dark yellowish orange (10YR6/6), as described above.

No recovery for this interval

SANDSTONE: Sandstone with some silt and clay - yellowish gray (5Y7/2) to dark yellowish orange (10YR6/6), as described above.

SANDY CLAYSTONE: Sandy Claystone with some silt - pale yellowish orange (10YR8/6) to medium light gray (N6), very fine- to fine-grained, well sorted, sub-angular to sub-rounded, approximately 11% porosity, argillaceous cement, moderately friable, sand contains abundant quartz, iron stain, some dark minerals, thinly laminated to thinly bedded, moist
25% sand, 10% silt, 65% clay

SILTY CLAYSTONE: Silty Claystone with some sand - light gray (N7), very fine-grained, very well sorted, sub-angular, approximately 7% porosity, argillaceous cement, moderately friable, sand contains abundant quartz, some dark minerals, trace iron stain, thinly to moderately laminated, moist
10% sand, 15% silt, 75% clay

No recovery for this interval

CLAYEY SANDSTONE: Clayey Sandstone with some silt - pinkish gray (5YR8/1), very fine- to medium-grained, moderately sorted, sub-rounded approximately 17% porosity, argillaceous cement, moderately to highly friable, sand contains abundant quartz, trace rock fragments, thin clay bed at 40.5-40.7', sand is loaded into clay bed along 40 degree surface, clay nodules-rip-up clasts at 40.5-41.3', thin bed of sandy clay at 44.3', approximately 50 degree bedding at 47.0-47.4' where unit is loaded into underlying unit, saturated.
55% sand, 17% silt, 28% clay

STATE PLANE COORDINATE		TOTAL DEPTH (FT): 54.0	GROUND ELEVATION (FT)	5957.74	PROJECT NUMBER	002/RI
NORTH:	749980.35	AREA: NE TRENCHES	CASING DIAMETER (IN)		GEOLOGIST	J.P. O'BRIEN
EAST:	2087401.67	LOCATOR NUMBER: H13	BOREHOLE DIAMETER (IN)	6.5	DATE DRILLED	12/02/91

LOG OF BORING NUMBER: 10191

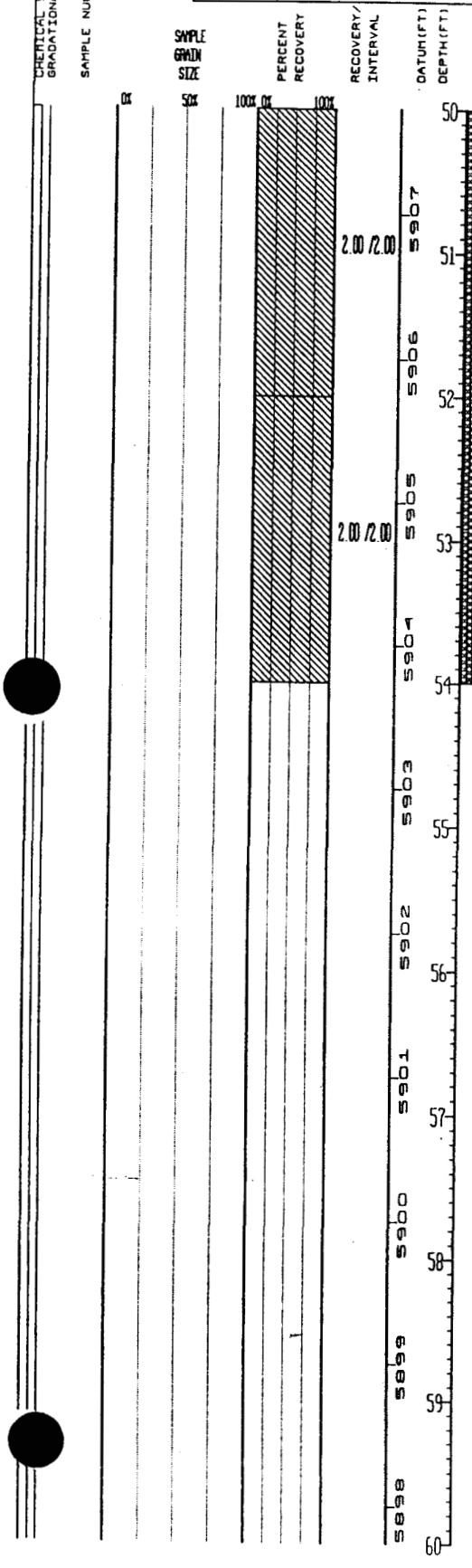
REMARKS: GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED, FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE.

CHEMICAL SA / GRADATIONAL	DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY / INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
			0% 50%	0% 100%	1.60 /1.00	5917	40				
							41				No recovery for this interval.
						5916	42			CLAYEY SANDSTONE	Clayey Sandstone with some silt - pinkish gray (5YR8/1), as described above.
					1.10 /2.00	5915	43				No recovery for this interval.
						5914	44			CLAYEY SANDSTONE	Clayey Sandstone with some silt - pinkish gray (5YR8/1), as described above
					2.00 /2.00	5913	45				
						5912	46				
					2.00 /2.00	5911	47				
						5910	48			CLAYEY SANDSTONE	Clayey Sandstone with some silt - light gray (N7) to medium light gray, very fine-grained, well sorted, sub-rounded to sub-angular, approximately 5% porosity, argillaceous cement, slightly friable, abundant quartz, some dark minerals, convolute bedding, slumps and pseudonodules at 52.0-54.0', dry. 40% sand, 15% silt, 45% clay. B
					2.00 /2.00	5909	49				
						5908	50				VOA sample obtained from this interval.

B00172002

STATE PLANE COORDINATE		TOTAL DEPTH (FT) 54.0	GROUND ELEVATION (FT)	5957.74	PROJECT NUMBER	002/RI	LOG OF BORING NUMBER
NORTH:	749980.35	AREA: NE TRENCHES	CASING DIAMETER (IN)		GEOLOGIST	J.P. O'BRIEN	10191
EAST:	2087401.67	LOCATOR NUMBER H13	BOREHOLE DIAMETER (IN)	6.5	DATE DRILLED	12/02/91	

REMARKS: GRAIN SIZE DISTRIBUTION AND DESCRIPTIONS ESTIMATED, FIELD READING INDICATE GREATER THAN 5 PPM (APPROXIMATELY 273 PPM)
RIG GEOLOGIST MARKED RECOVERY INTERVALS AT SITE



WELL OR PIEZOMETER CONSTRUCTION | LITHOLOGY | UNIFIED SOILS CLASSIFICATION OR ROCK TYPE | DESCRIPTION

CLAYEY SANDSTONE: Clayey Sandstone with some silt - light gray (N7) to medium light gray, as described above.

Total depth at 54.0 ft

Subject 10,000 GALLON TANK ANCHORS | Project No. 4045

By RJS | Checked By SAT | Task No. 110

Date 13 JUL 93 | Date 8-2-93 | File No. | Sheet 1 of 3

WIND LOADS @ ROCKY FLATS

$P = C_e C_q q_s I$ (UBC '91)

$C_e = 1.06$ (EXPOSURE C)

$C_q = 1.3$ (METHOD 2)

$q_s = 36.9$ psf (120 mph)

$I = 1.0$

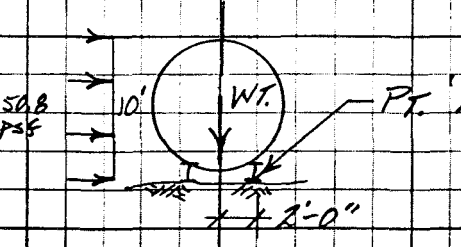
$P = 1.06\,(1.3)\,36.9\text{psf}\,(1.0) = \underline{50.8\ \text{psf}}$

ASSUMED TANK PROFILE —

HEIGHT = 10'-0"

LENGTH = 28'-0"

TANK WT = 93541b (EMPTY)



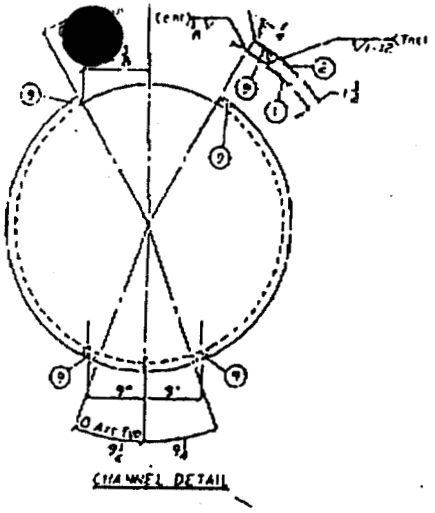
CHECK OVERTURNING EMPTY:

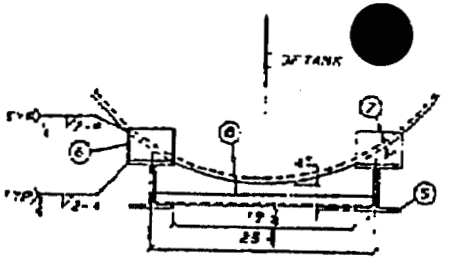
$M_{OT} = (50.8\text{psf})\,10'(28')\,5' = 71{,}120^{ft\text{-}lb}$

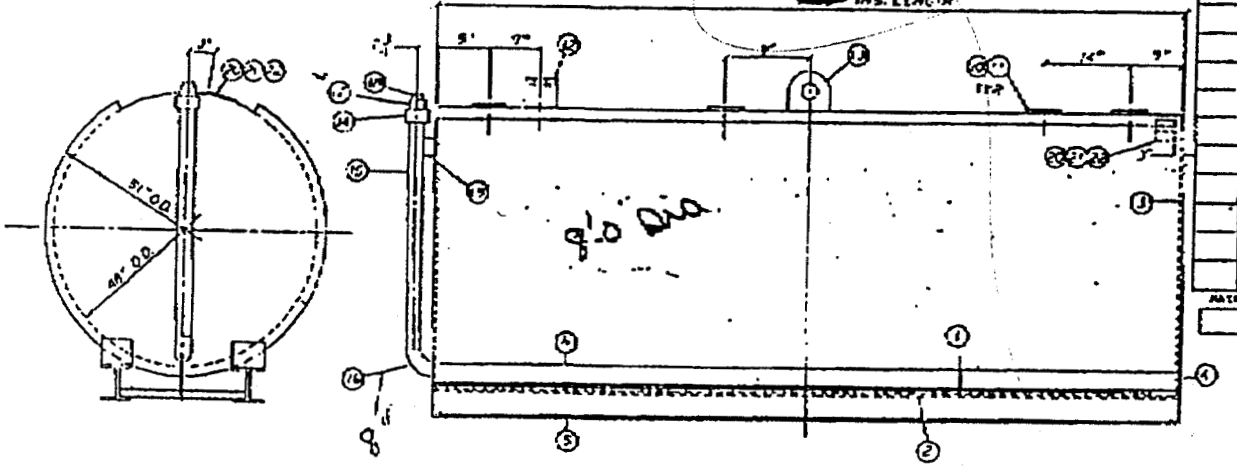
$M_{RESIST} = 93541^{lb}(2') = 18{,}708^{ft\text{-}lb}$ (SEE Pg. 2)

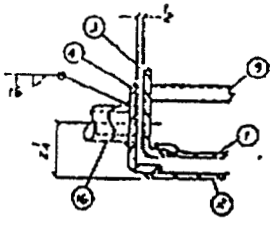
$F.S. = \frac{M_{RESIST}}{M_{OT}} = \frac{18708}{71120} = 0.26$ (1.50 REQ'D BY CODE)

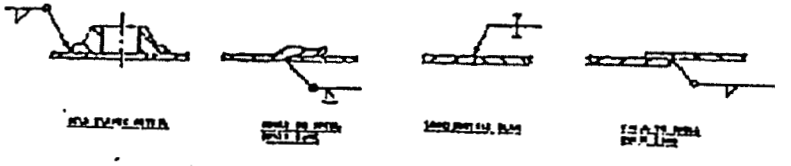
∴ ANCHOR TANK











OWG NO	C-D-4631	By	Date	EMP Job No
		Chkd	Rev	Customer

SHIP PC	MARK NO	ASSM PC	DESCRIPTION	LENGTH FT	LENGTH IN	NAIL SPEC	WEIGHT
	1-1	2	10 Gauge C-6"	12	7 1/16		
	1-2	2	10 Gauge 63"	11	2 5/8		
	1-3	2	10 Gauge 47 1/4 Dia. F. & Head				
	1-4	2	10 Gauge 51" Dia. F.F. Head				
	1-5	2	W6 x 15 Wide Flange	11	6		
	1-6	2	1/4 Plate 3 1/2	11	6		
	1-7	4	1/2 Plate 3 1/2	-	6		
	1-8	2	3" x 3" x 1/4 Angle	2	1/2		
	1-9	4	C3 x 4.1 Channel	11	0		
	1-10	4	4" Weld Flange				
	1-11	4	4" Thread Protector				
	1-12	1	6" Sch. Pipe TOE	-	6		
	1-13	1	L1-1 Lifting Loop				
	1-14	1	2" Std. Wt. Full Coup. Sch.				
	1-15	1	2" Sch. 40 Pipe TOE	3	6		
	1-16	1	2" Std. Wt. 90° L.R. Weld Ell				
	1-17	1	2" x 2" Nylon Bushing				
	1-18	1	Vacuum Assembly				
	1-19	1	7 Gauge 1/2	-	2 1/4		
	1-20	1	EMP Std. Nameplate				
	1-21	1	UL Label Bracket				
	1-22	1	UL Label				
	210 Sq. Ft.		Shop Primer				

MATERIAL LISTED IS FOR ONE TANK — MATERIAL LISTED IS MINIMUM REQUIRED

REQUIRED

UNDER TANK WEIGHT IS IN ACCORDANCE WITH UL-142 SPECIFICATIONS

NO	DATE	REVISIONS

	PRINT	RECORD
CHECKED		PAINT NOTE
APPROVAL		SHOP DATE
FINAL APPROVAL		

EATON METAL PRODUCTS CO.
DENVER, COLORADO • SALT LAKE CITY, UTAH

360

ABOVE GROUND DUAL WALL - ~~STEEL~~ TYPE ~~II~~ W/SKID
1000 GALLON 48" DIA. x ~~48'-0"~~ 27'0" LONG STORAGE TANK

	DATE	SHOP NO.	REV
DRN BY L.C.	7-30-93	C-D-4631	
CHKD BY			

EPOXY COATING
1/4 CORROSION ALLOWANCE

296-4800

Subject 10,000 GALLON TANK ANCHORS

Project No. 4045

By RJS

Checked By S.AT

Task No. 110

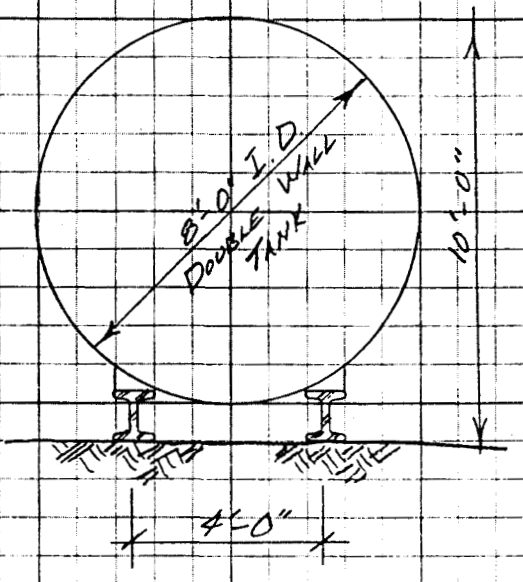
File No.

Date 13 JUL 93

Date 8-2-93

Sheet 2 of 3

EMPTY TANK WEIGHT



INSIDE LENGTH = 27'-0"

TANK SKIN AREA:

ENDS = $2(4)^2\pi$ = 100.5 ft²

SIDES = $2(4)\pi(27)$ = 678.6 ft²

≅ 780 ft²

TANK WALL WT.:

2 - 10 GAGE WALLS

$2(5.64\ ^{lb}/_{ft^2})$ = 11.3 $^{lb}/_{ft^2}$

TOTAL TANK WT = 11.3 $^{lb}/_{ft^2}$ × 780 ft² = 8814 lb

SKID WT = (2) 10 $^{lb}/_{ft}$ (27') = 540 lb

9354 lb

Subject 10,000 GALLON TANK ANCHORS

Project No. 4045

By RJS

Checked By SAT

Task No. 110

File No.

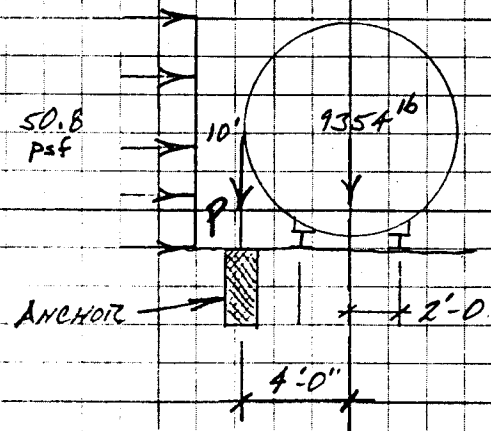
Date 13 JUL 93

Date 8-2-93

Sheet 3 of 3

CALCULATE LOAD ON ANCHORS

- ASSUME 4 ANCHORS (2 OF EACH SIDE)
- EACH ANCHOR IS LOADED WITH 50% OF OT TENSION



$$M_{OT} = (50.8_{psf})\left(\frac{28'}{2}\right)10'(5') = 35,560\ ft\text{-}lb$$

$$M_{RESIST} = \frac{9354^{lb}(2') + (6')P}{2}$$

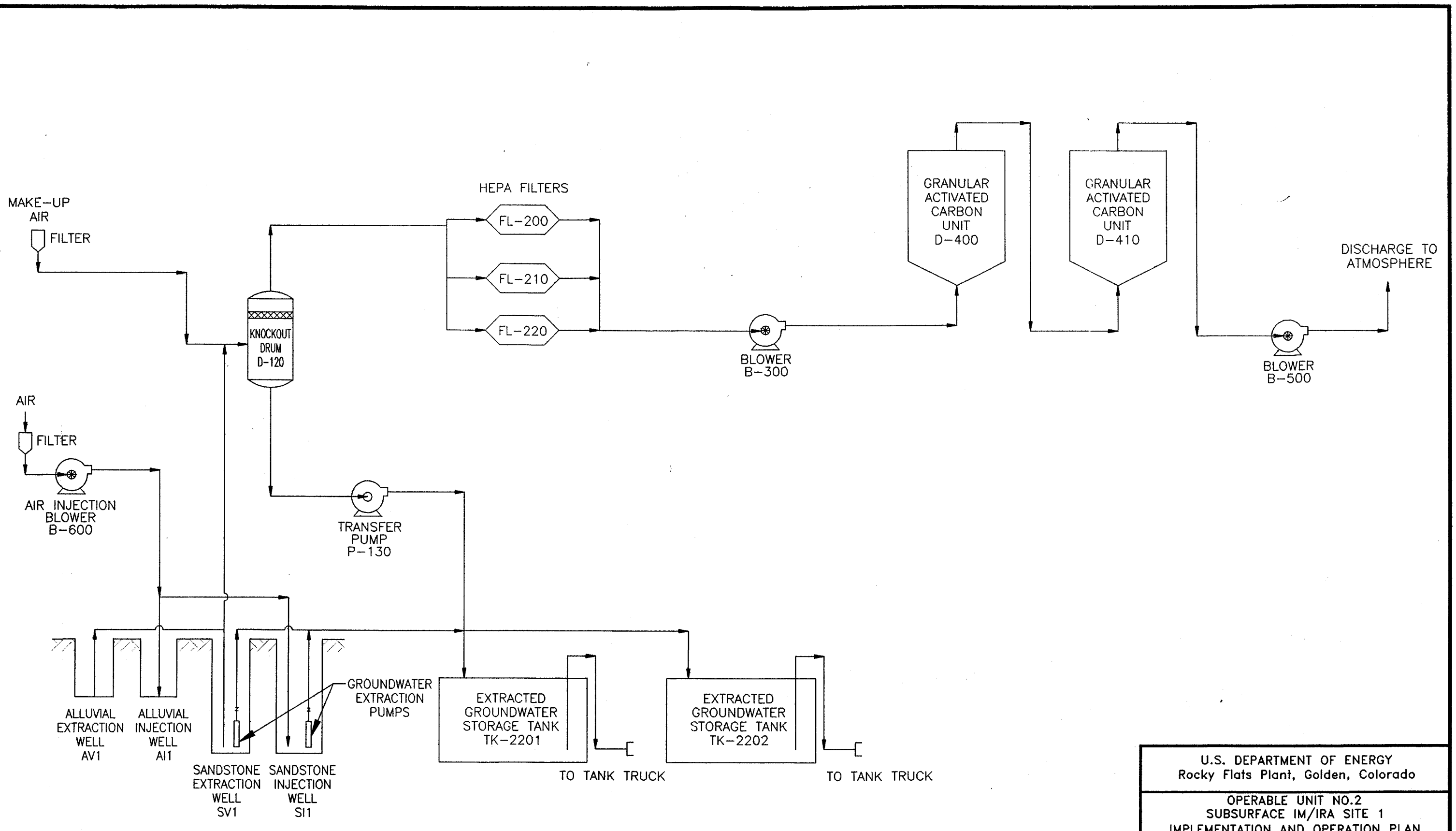
$$F.S. = \frac{M_{RESIST}}{M_{OT}} = 1.5$$

$$\therefore 1.5(35,560) = 9354 + 6P$$

$$P = 7,331^{lb}\ (\text{PER ANCHOR})$$

∴ USE 4 ANCHORS
(2 ON EACH SIDE)

Woodward-Clyde



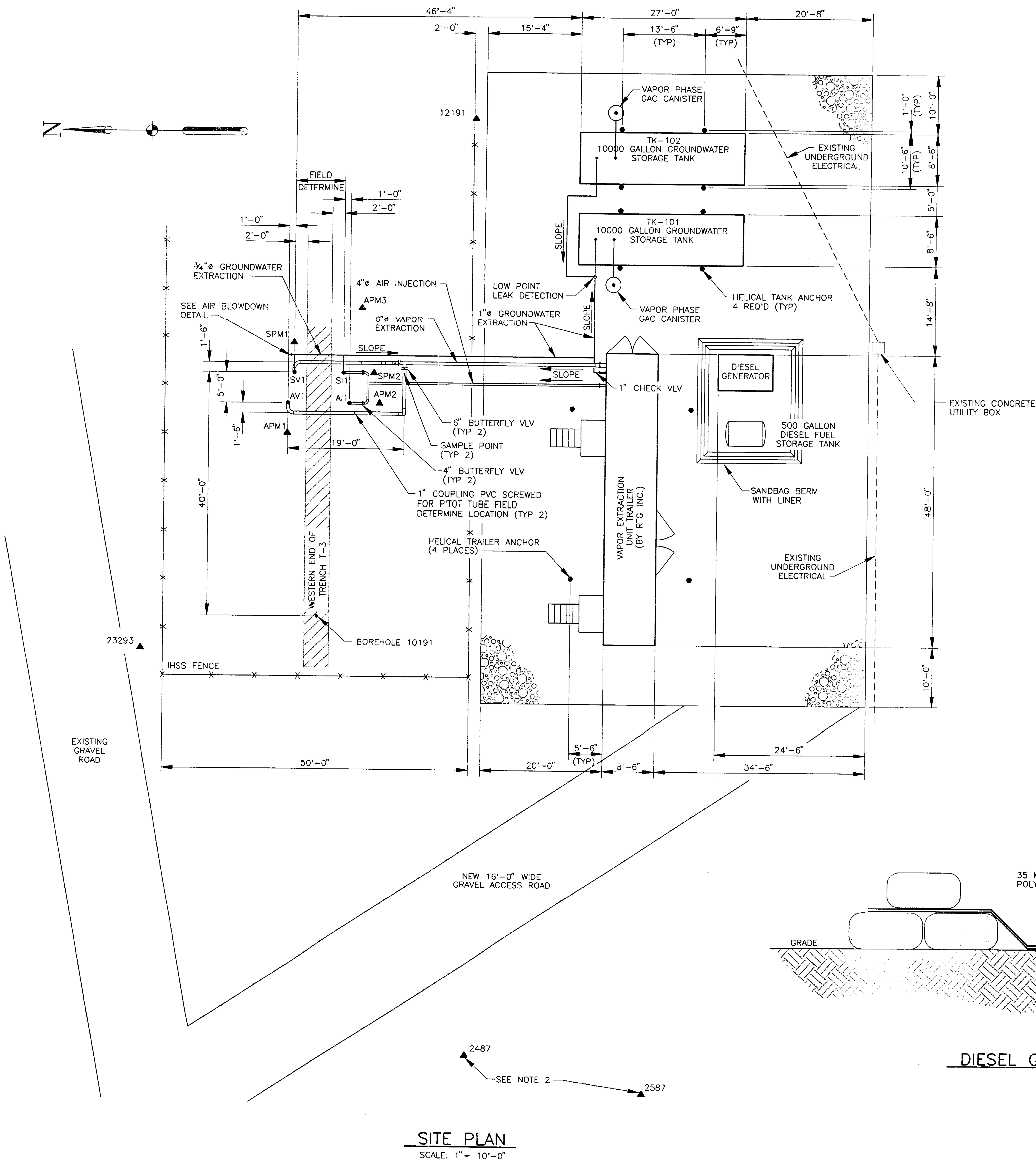
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO.2
SUBSURFACE IM/IRA SITE 1
IMPLEMENTATION AND OPERATION PLAN

SOIL VAPOR EXTRACTION
PROCESS FLOW DIAGRAM

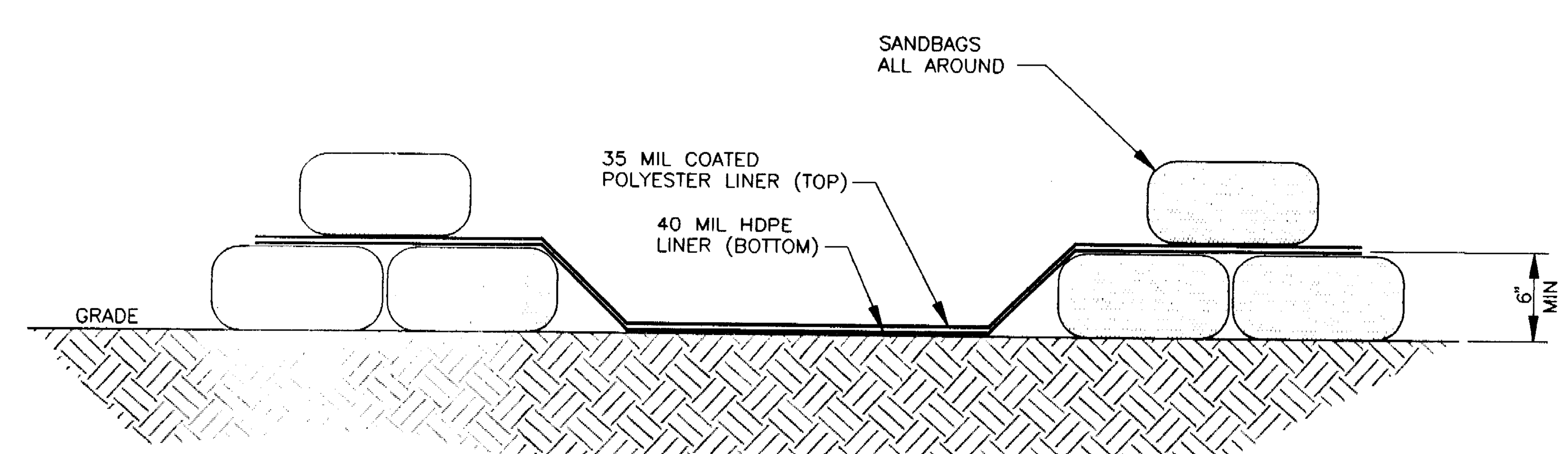
FIGURE 2-1 JANUARY 1994

40451001 1=1



SITE PLAN

SCALE: 1" = 10'-0"



DIESEL GENERATOR BERM DETAIL

17'-0" X 15'-0"
950 GALLON CAPACITY
NTS

LEGEND

SV1 VAPOR AND GROUNDWATER EXTRACTION WELL
AV1 VAPOR EXTRACTION WELL
SI1 AIR INJECTION AND GROUNDWATER EXTRACTION WELL
AI1 AIR INJECTION WELL
▲ MONITORING WELL

NOTES

1. LINE BETWEEN SV1 AND SI1 TO BE WITHIN 10 LINEAR FEET OF FIELD FLAG 110-7.
2. ACCESS ROAD TO BE ROUTED AROUND EXISTING MONITORING WELLS. THREE BALLARDS TO BE PLACED AROUND WELLS.
3. TRAILER SUPPLIED BY RTG INC.
4. WELL DETAILS PROVIDED IN FINAL PILOT TEST PLAN. EG&G JANUARY 1993.
5. P&ID PROVIDED IN FINAL PILOT TEST PLAN. EG&G JANUARY 1993.
6. MAXIMUM PIPE SUPPORT SPACING SHALL BE AS FOLLOWS:

   GROUNDWATER PIPING 7'-0"
   VAPOR EXTRACTION PIPING 8'-0"
   AIR INJECTION PIPING 14'-0"

KEYWORDS	ISSUE	DESCRIPTION	BY	DATE
1. SOIL	A	ORIGINAL		
2. VAPOR	DESIGNED		DWG	
3. EXTRACTION	DRAWN		DWG	
4.	CHECKED		TRT	
5.	APPROVED		MDK	
BLDG./FACILITY: SITE				
ROOM/AREA				
GRID COORD./COL NO.	SUBMITTED			
MASTER YES ☐ NO ☐	APPROVED RFP			
	APPROVED DOE			

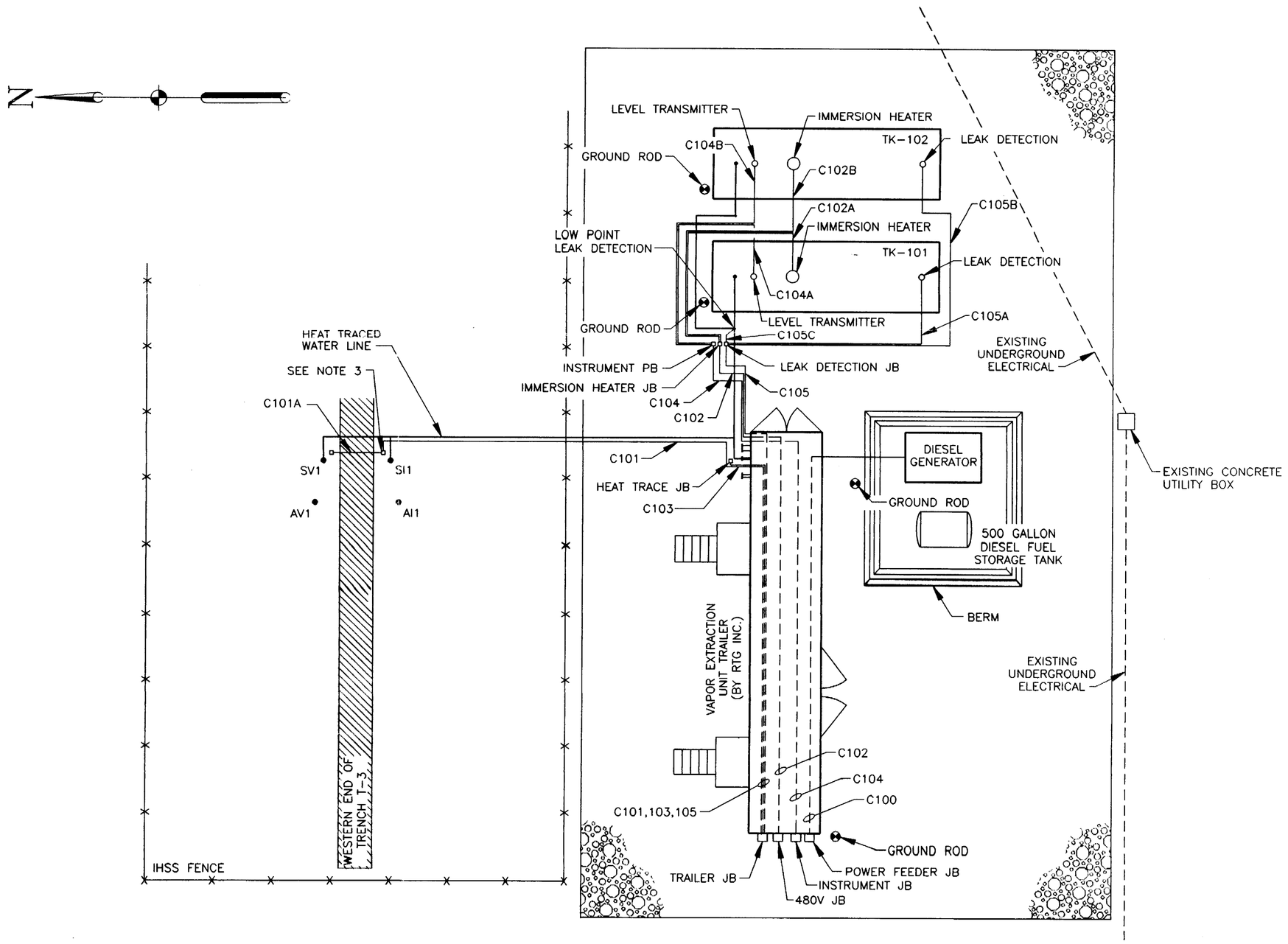
DATE	RFP			DOE	CLASS	JOB NO.
7/26/93	DWG	DWG	TRT	MDK		989011

U. S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE — GOLDEN, COLORADO

ROCKY FLATS PLANT
GOLDEN, COLORADO 80402-0464

SUBSURFACE IM/IRA
EAST TRENCHES AREA
GENERAL SITE PLAN

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	50715-101	A	1 OF 1



ELECTRICAL SITE PLAN

SCALE: 1" = 10'-0"

CABLE SCHEDULE

CONDUIT NO.	FROM	TO	SIZE	CABLE
C100	DIESEL JB	POWER FEEDER JB	1½"	3-1/0 AWG, 1#6 GND
C101	TRAILER JB	WELL PUMP SI1 JB	¾"	12-#12 AWG, 2#12 GND *
C101A	WELL PUMP SI1 JB	WELL PUMP SV1 JB	¾"	6-#12 AWG, 1#12 GND
C102	TRAILER 480V JB	TANK IMMERSION HTR JB	¾"	6-#10 AWG, 2#10 GND
C102A	TANK IMMERSION HTR PB	TK-101 IMMERSION HTR	½"	3-#10 AWG, 1#10 GND
C102B	TANK IMMERSION HTR PB	TK-102 IMMERSION HTR	½"	3-#10 AWG, 1#10 GND
C103	TRAILER JB	HEAT TRACING JB	½"	2-#12 AWG, 1#12 GND
C104	TRAILER INSTRUMENT JB	INSTRUMENT PB	½"	2-#18 TSP
C104A	INSTRUMENT PB	TK-101 LEVEL SENSOR	½"	1-#18 TSP
C104B	INSTRUMENT PB	TK-102 LEVEL SENSOR	½"	1-#18 TSP
C105	TRAILER JB	LEAK DETECTION JB	½"	2-#12 AWG, 1#12 GND
C105A	LEAK DETECTION JB	TK-101 LK DET SENSOR	½"	TRACETEK JUMPER CABLE
C105B	LEAK DETECTION JB	TK-102 LK DET SENSOR	½"	TRACETEK JUMPER CABLE
C105C	LEAK DETECTION JB	PIPE LK DET SENSOR	½"	TRACETEK JUMPER CABLE

* 4-#12 AWG FOR POWER- 2 PUMPS, 4-#12 AWG FOR HIGH LEVEL SWITCHES (ONE IN EACH WELL) AND 4-#12 AWG FOR LOW LEVEL SWITCHES.

NOTES

1. PROVIDE WEATHERPROTECTED NEMA 12 JUNCTION BOXES SIZED IN ACCORDANCE WITH THE NEC FOR THE WIRE AND CABLE INDICATED.
2. THE LEAK DETECTION JUNCTION BOX SHALL BE MOUNTED FOR EASE OF ACCESSIBILITY AND SHALL CONTAIN THE LEAK DETECTION ALARM AND LOCATOR MODULE, AND A THERMOSTATICALLY CONTROLLED SPACE HEATER. ALARM MODULE AND SPACE HEATER POWER ARE PARALLELED IN THE JUNCTION BOX.
3. THE WELL PUMP JUNCTION BOXES SHALL CONTAIN 2-P MOTOR DISCONNECTS IN ACCORDANCE WITH THE NEC.
4. PROVIDE HEAT TRACING ON ALL WATER PIPING.
5. FIELD ROUTE ALL CONDUIT IN A NEAT MANNER GROUPING CONDUITS AS MUCH AS POSSIBLE AND USING WATER PIPE SUPPORTS TO THE EXTENT THEY ARE AVAILABLE. PROVIDE PULL BOXES AS REQUIRED BY THE NEC.
6. THE IMMERSION HEATER JUNCTION BOX SHALL CONTAIN TWO 3-P 20 AMP DISCONNECTS, ONE FOR EACH HEATER.

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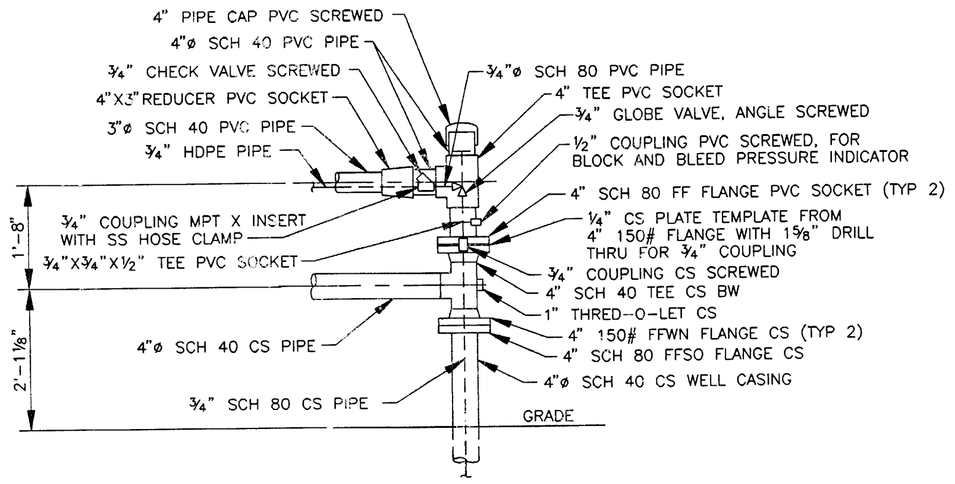
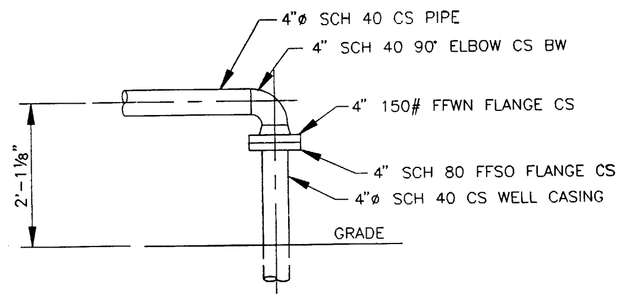
KEYWORDS	A	ORIGINAL			7/26/93	DWG	DWG	TRT	MDK		989011
1. SOIL	ISSUE	DESCRIPTION			DATE		RFP		DOE	CLASS	JOB NO.
2. VAPOR			BY	DATE	U. S. DEPARTMENT OF ENERGY						
3. EXTRACTION	DESIGNED		DWG		ROCKY FLATS AREA OFFICE					GOLDEN, COLORADO	
4.	DRAWN		DWG		ROCKY FLATS PLANT						
5.	CHECKED		TRT		GOLDEN, COLORADO 80402-0464						
BLDG./FACILITY SITE	APPROVED		MDK		SUBSURFACE IM/IRA						
ROOM/AREA					EAST TRENCHES AREA						
GRID COORD./COL. NO.					ELECTRICAL SITE PLAN						
	SUBMITTED				SIZE	DRAWING NUMBER				ISSUE	SHEET
MASTER	APPROVED RFP				D	50715-102				A	1 OF 1
YES ☐ NO ☐	APPROVED DOE										



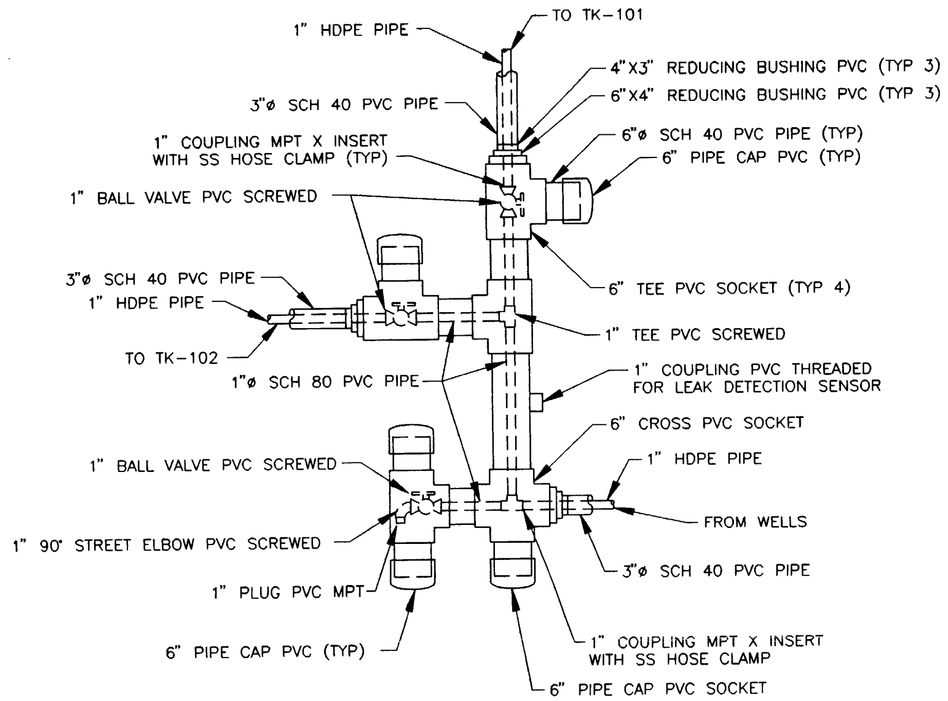
SI1 WELLHEAD DETAIL

SEE NOTE 4
NTS



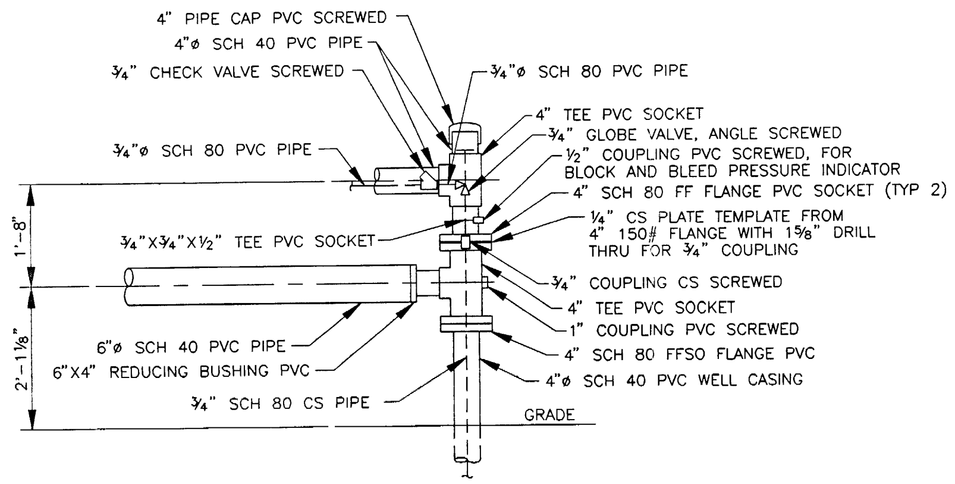
AI1 WELLHEAD DETAIL

SEE NOTE 4
NTS



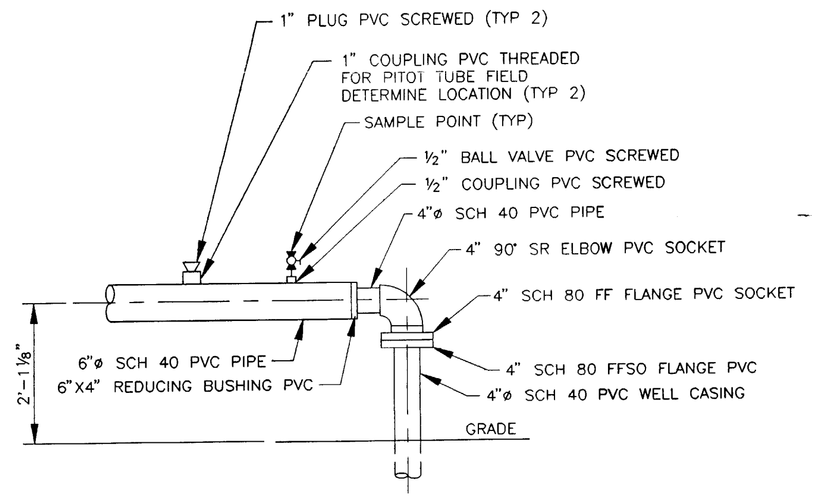
LOW POINT LEAK DETECTION AND SAMPLE POINT DETAIL

NTS



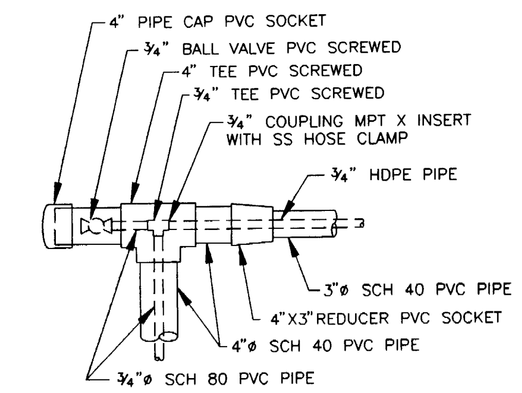
SV1 WELLHEAD DETAIL

SEE NOTE 4
NTS



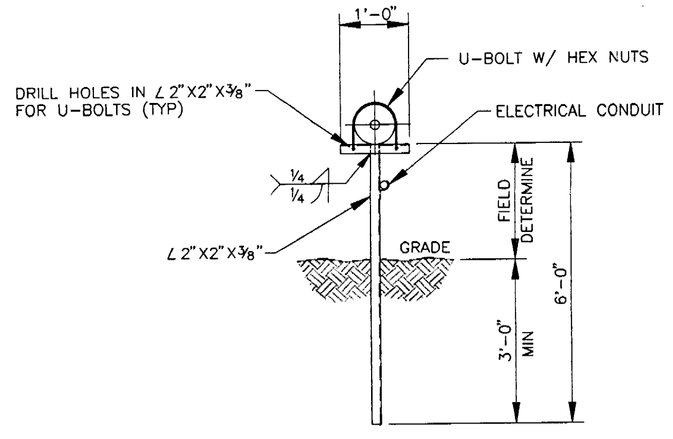
AV1 WELLHEAD DETAIL

SEE NOTE 4
NTS



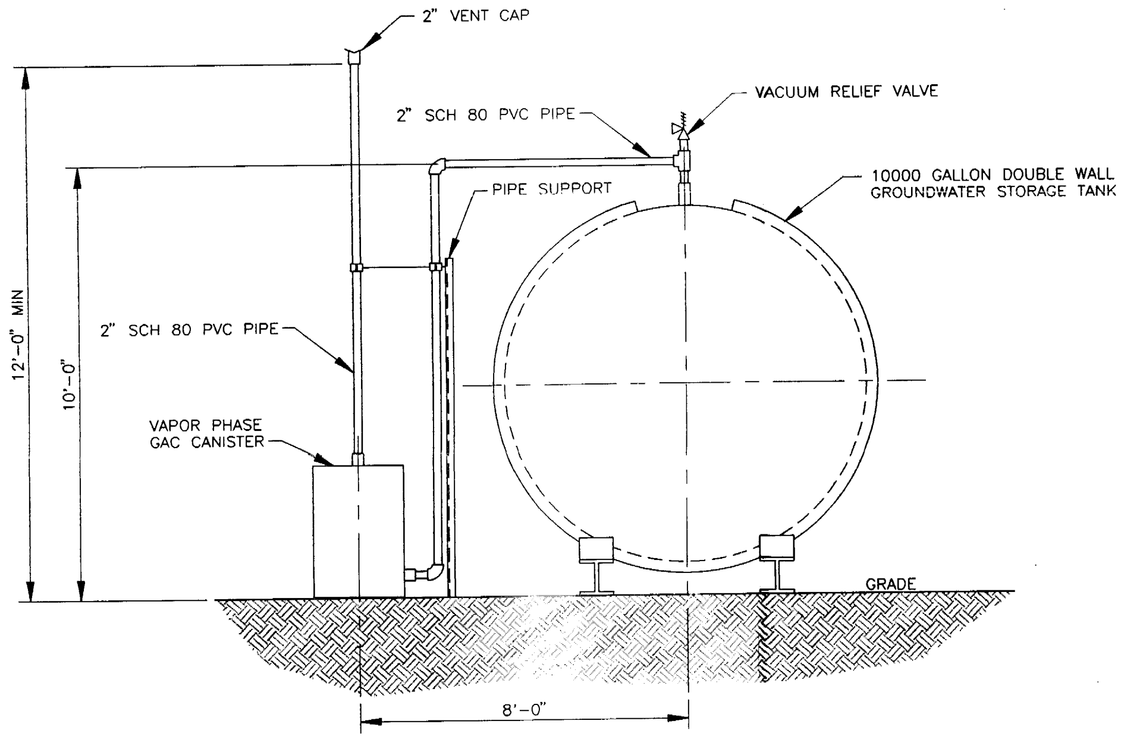
AIR BLOWDOWN DETAIL

NTS



TYPICAL PIPE SUPPORT DETAIL

NTS



TYPICAL GAC CANISTER INSTALLATION DETAIL

NTS

KEYWORDS	A	ORIGINAL		7/26/93	DWG	DWG	TRT	MDK	989011
1. SOIL	ISSUE	DESCRIPTION		DATE	RFP		DOE	CLASS	JOB NO.
2. VAPOR		BY	DATE	U. S. DEPARTMENT OF ENERGY					
3. EXTRACTION	DESIGNED	DWG		ROCKY FLATS AREA OFFICE				GOLDEN, COLORADO	
4.	DRAWN	DWG		ROCKY FLATS PLANT					
5.	CHECKED	TRT		GOLDEN, COLORADO 80402-0464					
BLDG./FACILITY SITE	APPROVED	MDK		SUBSURFACE IM/IRA					
ROOM/AREA				EAST TRENCHES AREA					
GRID COORD./COL. NO.				PIPING DETAILS					
	SUBMITTED			SIZE	DRAWING NUMBER			ISSUE	SHEET
MASTER	APPROVED RFP			D	50715-103			A	1 OF 1
YES ☐ NO ☐	APPROVED DOE								

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